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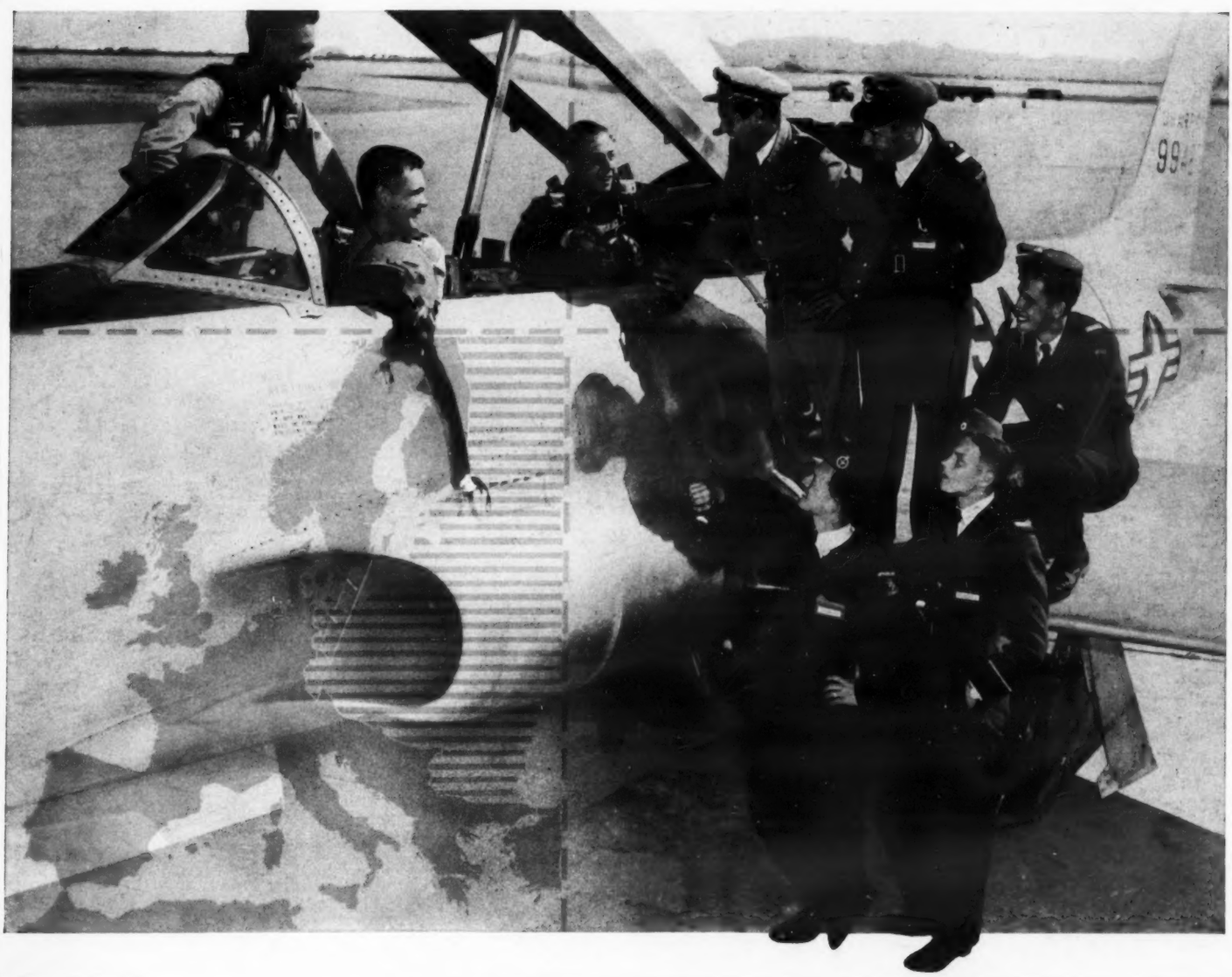

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N.A.T.O. AIR BUILD-UP

VOLUME VII 8 1952

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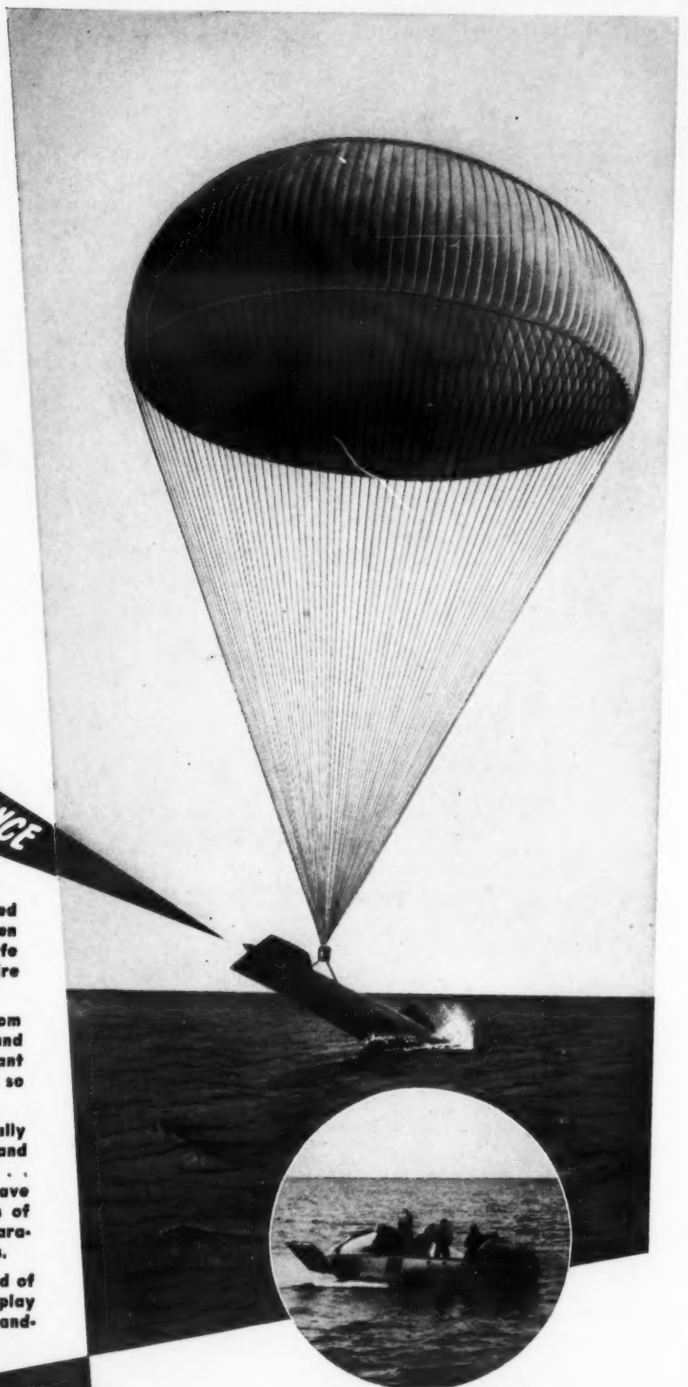

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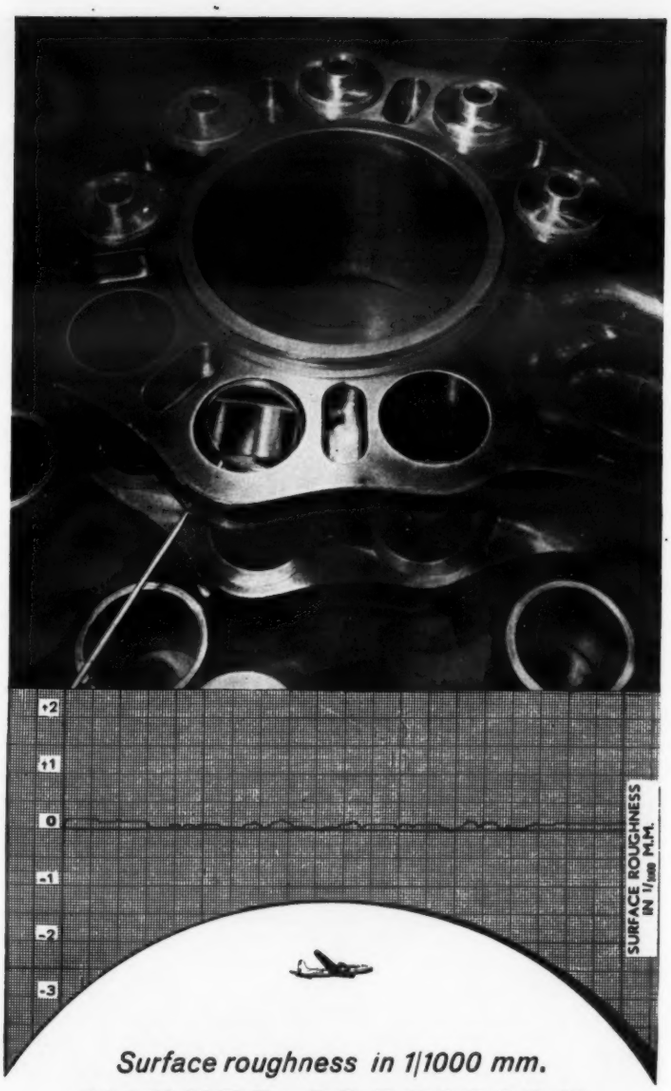

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Lockheed does more than apply *existing* electronics. Often, no device is available to perform a specific job. At such a time, Lockheed scientists provide the all-important idea, frequently supplying the basic design for a new product. Then they turn it over to an electronics company for manufacture.

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America's first All-Weather Interceptor, the Lockheed F-94, is a current result of Lockheed's policy. Not being a manufacturer of electronics, non-competitive Lockheed can work closely with companies who are, as well as the U.S. air services. As a result the F-94 was *electronically at least two years ahead* of competitive aircraft.

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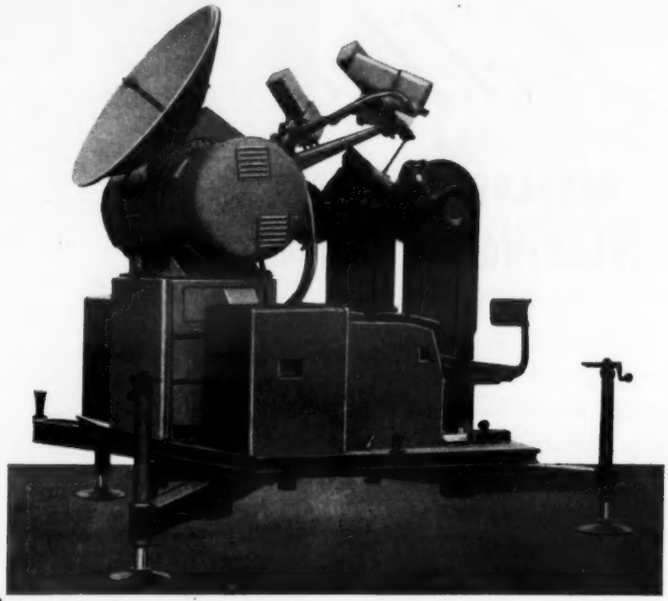

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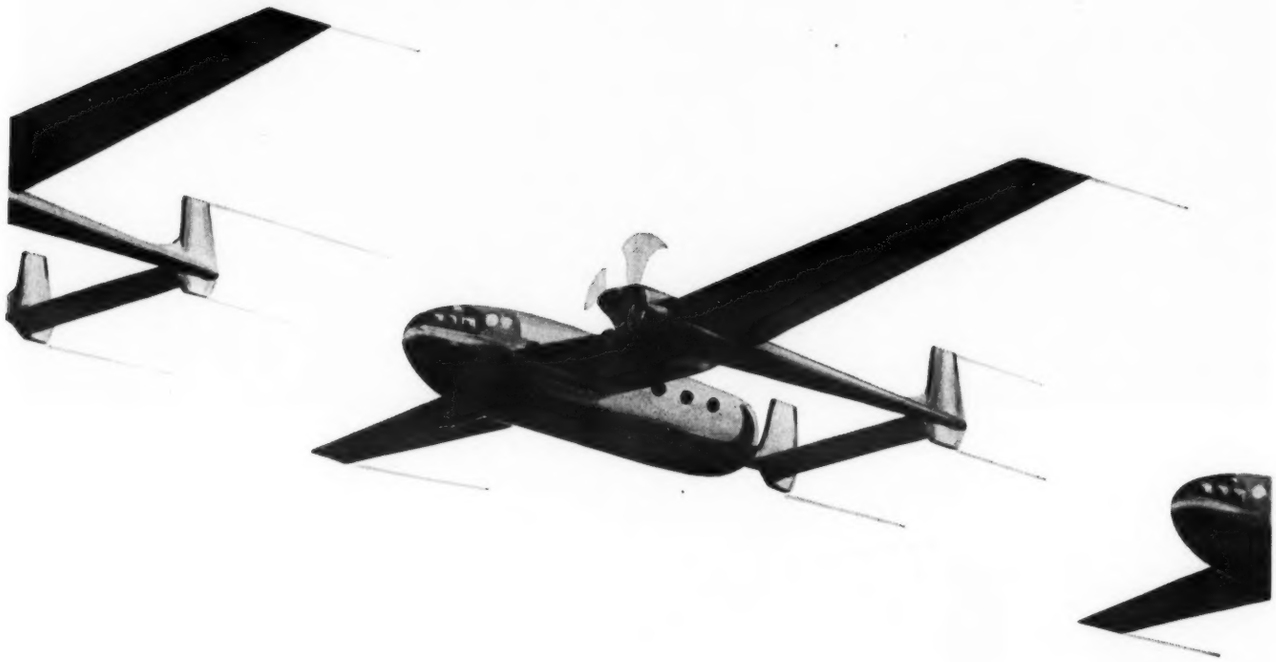

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* The Saab-Fokker co-operation for continued Scandia production is similar to the arrangement under which another Dutch aircraft manufacturer—the De Schelde factory—is producing the popular Saab-91B Safir Trainer/Tourer under sub-contract for Air Force and airline customers, taxi operators, private owners, etc.

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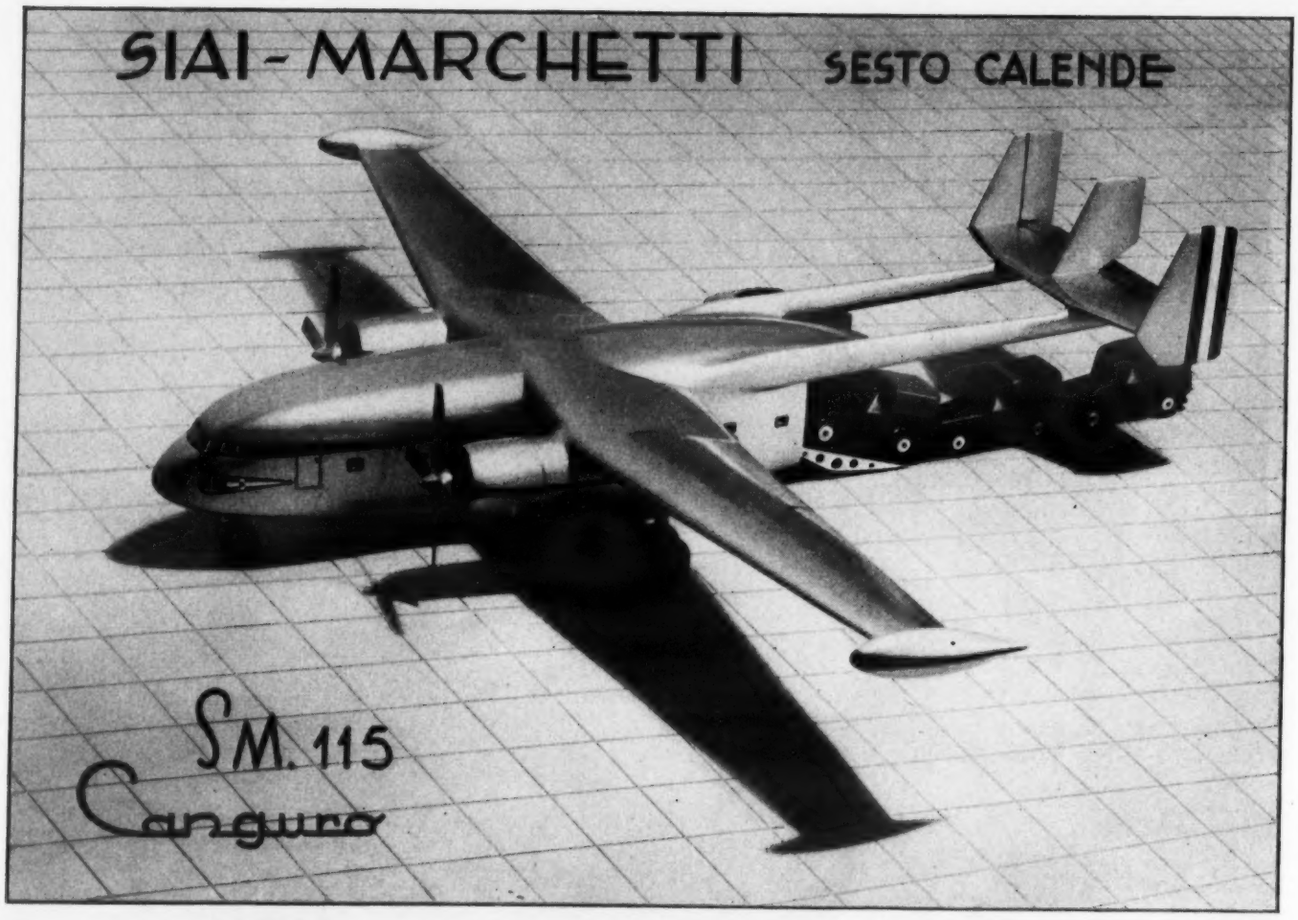

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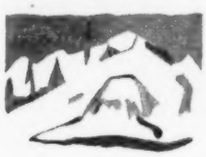

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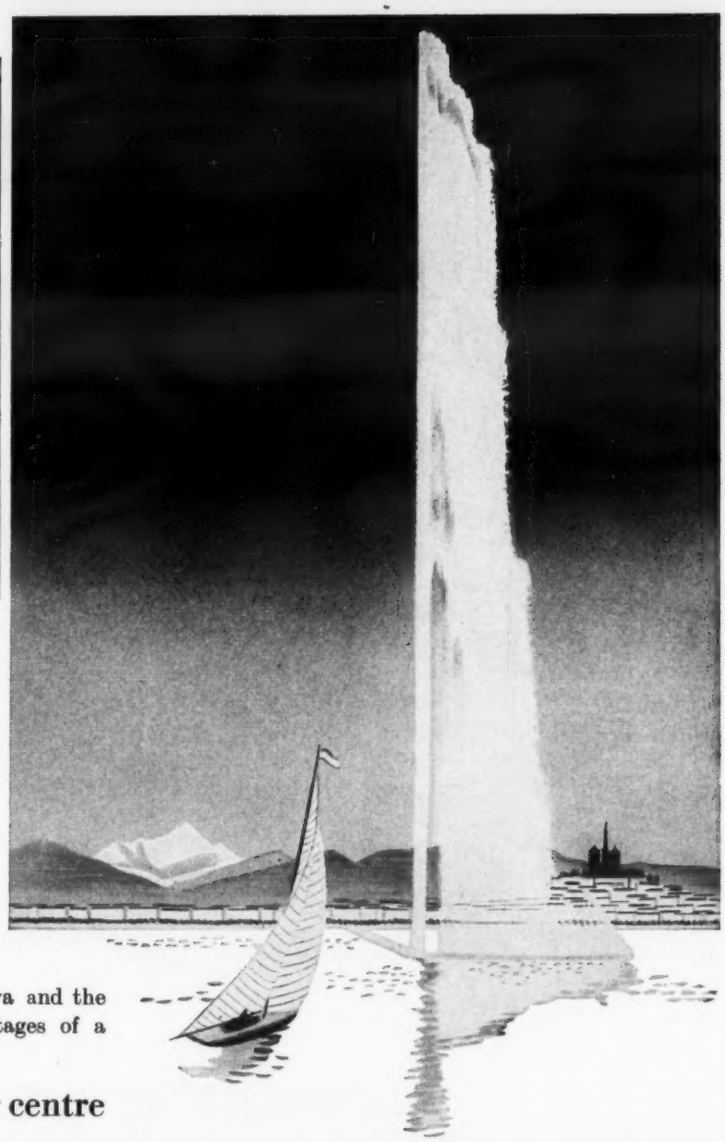

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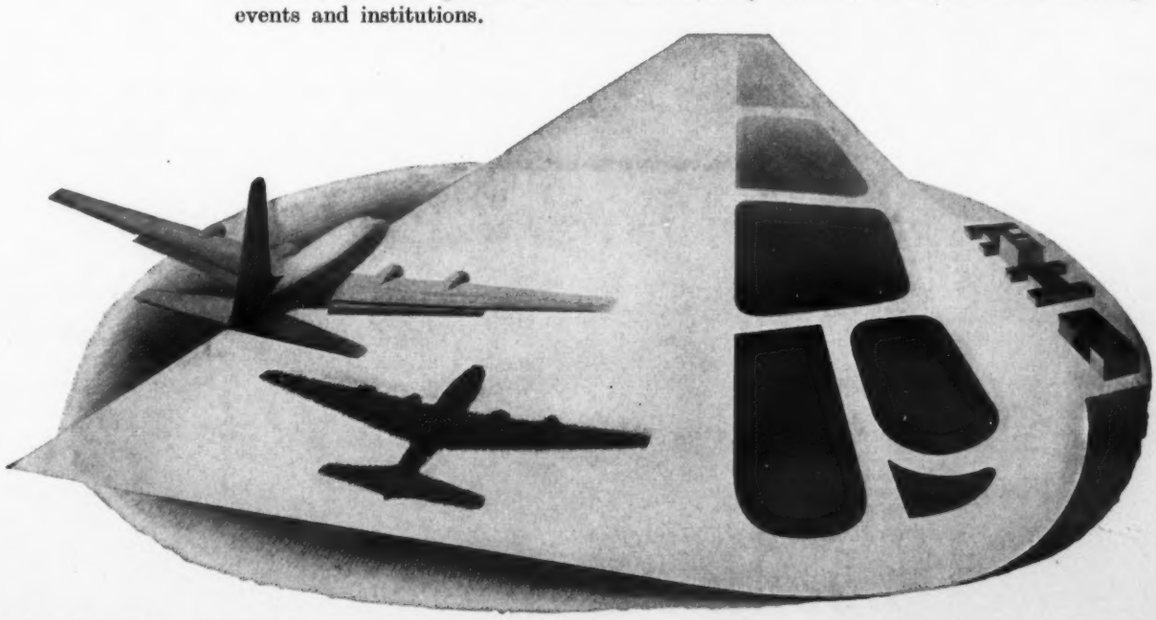

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NATO Air Build-Up

NATO Air Power in Europe—Bulwark Against the East

To the Command of the Allied Air Forces in Central Europe in particular and the NATO [1] air forces more generally have been assigned missions of an importance unprecedented in the annals of the "cold war." If an armed conflict were to break out in Europe, the NATO powers would have to hold a front stretching from the North Cape to Turkey—a front along which the fate of more than 250 million people would be decided.

Taking into account the contributions from the USA and Canada, 14 nations—including eleven maintaining their own air force units—would share in the task of stopping any breaches occurring along a front of several thousand miles. But in an emergency the strategy of the NATO air forces and particularly of the Allied Air Forces in Central Europe—the cornerstone of European air strength—will aim at more than purely defensive action. The duties of NATO's air power in Europe are multiple and inseparable. They are :

— to interdict Europe's air space to foreign aircraft and long-range missiles, and this along a front of nearly 3,000 miles ;
— to provide close support to friendly land forces and hamper the enemy's freedom of movement ;
— to carry out long- and short-range retaliatory attacks and to keep open the shipping lanes in the Atlantic, the North Sea and the Mediterranean.

While the diversity of these tasks is considerable and their fulfilment difficult, everything would depend upon their successful accomplishment, for the main purpose of NATO's air power is to reestablish in favour of the Western Allies the balance of military power that has been lost as a result of the potential enemy's preponderant land forces. The problem today is to build up a closely integrated aerial combat weapon using standardized procedures and equipment, taking into account at the same time differences of language, national customs and past history. This, roughly, is the second aspect of an involved problem.

[1] NATO = North Atlantic Treaty Organization.

A symbol of NATO cooperation : a Chance Vought F7U-1 "Cutlass" naval jet fighter bearing the significant registration "415 NATO."

In less than two years much progress has been made—the numerous international air exercises in the skies of Europe are ample proof of this. A basis has been created, and on this basis NATO's West European air arm is now being built up.

General Lauris E. Norstad, Commander-in-Chief, Allied Air Forces, Central Europe—one of the USAF's top strategists

One of the names in NATO's European air set-up most frequently in the news is that of General Lauris E. Norstad, Commander-in-Chief, Allied Air Forces, Central Europe.

The youngest four-star general of the USA : General Lauris E. Norstad, Commander-in-Chief, Allied Air Forces, Central Europe.

At the age of 45 Lauris Norstad has just been promoted a "four-star general"—i.e., from Lieutenant General to full General. In 1939, when the Nazis attacked Poland, Norstad was a first Lieutenant. Six years later he became the youngest Brigadier General of the U.S. Army, after the U.S. Congress had voted a special law to make his unusual nomination possible.

Upon graduating from West Point, Norstad was assigned to the 18th Pursuit Group in Hawaii. At the time of the North African invasion of November 1942 he directed the air operations of the amphibious assault. He held a similar post in the Mediterranean during the Allies' northward advance. After that he moved to the Far East as Chief of Staff to the U.S. Twentieth Air Force, that powerful striking force which dealt the final blow to Japan. V-J Day found him in Washington at USAF Headquarters as Deputy Chief of Staff, Operations. Later he assumed the post of Vice-Chief of Staff.

His combat experience in East and West and the knowledge he acquired as a top staff planner qualified him to become one of the architects of the U.S. armed forces unification act and one of the closest collaborators of Thomas K. Finletter, today Secretary of the Air Force, when the latter drafted his significant report, "Survival in the Air Age," in 1948, culminating in a demand for a minimum air strength of 70 wings.

The latest developments in the world situation have resulted in the creation of SHAPE [2] and, as part of it, the command of "Allied Air Forces, Central Europe." The latter command has been entrusted to General Norstad. In that post he must deal not only with strategic and tactical problems, but also with questions of politics and geography of an area of operations in which the air forces of at least six nations must stand ready as one integrated, efficient combat weapon.

[2] Supreme Headquarters, Allied Powers, Europe.

NATO Air Build-Up

Air Power, an Instrument for European Unity

BY LIEUTENANT-COLONEL PIERRE M. GALLOIS, PARIS

Cooperation within NATO's air forces : Left to right : General Lauris E. Norstad, C.-in-C., Allied Air Forces, Central Europe ; Lieut.-Col. Pierre M. Gallois, of the French Air Staff (author of this article); and Pierre Montel, France's Air Minister.

In Europe the defence of the Western world presents the anomaly that the main front to be defended is a land one, whereas the principal weapon is the air arm. It is imperative that the vast peninsula stretching from the Baltic to the Mediterranean along the flanks of Eurasia should be denied to an enemy. The Western nations' economy, industry and scientific standards on the one hand, and their outlook on the other, are such that the air arm must be called upon to *restore the balance of inferior land and under-water forces.* Taking the manpower and energy available as a basis, it is easy to calculate the potential size of the surface forces. Their upper limit is known and everyone realises that they cannot swing the balance. The Western world's own resources determine what these forces shall be ; they appear to be cut to the Allied cloth and not to that of the adversary. It is therefore the variable "air" which must compensate for the limitations of the constant "land."

Up to the present the air arm's power of elasticity has not been demonstrated. In addition to the factors habitually cited to justify the limited number of land divisions it is possible to create, several limiting arguments have been put forward when the new air weapons have come up for discussion. Reams have been written about the cost of modern flying equipment, its complexity and the vast number of highly skilled personnel required to operate it intelligently. Its demands on the physical and intellectual capacities of crews have been heavily stressed, and so has the burden it represents on the various national economies. But there have also been glimpses of a fair number of possible new methods of sharpening the cutting edge of the air arm without retempering the blade or reinforcing the hilt.[1] These suggestions have been more concerned with the technical improvement of air combat equipment than with the advantages of a genuine far-reaching integration of the different air resources at the disposal of the Western nations. The needs of Western European defence, on the one hand, and the technical and industrial air potential of the countries of Western Europe, on the other hand, demand that the question be broached. It would seem, for once, that the problem is political rather than financial, since the funds provided by the Atlantic countries for their respective air forces are greatly in excess of the air budgets of the opposing *bloc.*

[1] Cf. INTERAVIA, 1952, No. 7, p. 364

This apparent contradiction which gives the air arm pride of place on a front which must be held on land reappears in the very nature of the air power assembled for this purpose. Western Europe is seeking to found its security on the combination of two factors : indirectly on American power, on the United States' determination and their feeling of vulnerability four thousand miles from their own frontiers ; directly, on the strength deployed on European territory from both its own resources and those of other Atlantic powers, primarily the United States and Canada.

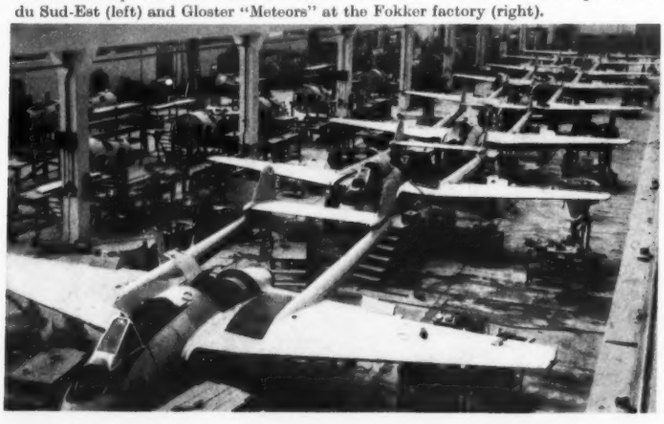
Thus direct security, to speak only of this aspect, rests on the combination of internal and external resources. Both because the origins of these forces are different and because they have been so recently grouped together, there are disparities between them.

"National vocations" are not always complementary

Geography, economics and technical development decide national air policies, which consequently differ very greatly one from another. All coalitions of any importance benefit from the co-ordination of complementary elements and from having at their disposal a complete range of air weapons. They lose, however, to the extent that, when the various national contributions are too unequal, the most powerful weapons are not all adapted to the theatre concerned.

It has been said that the great financial cuts of 1948 led the U.S. Air Force to concentrate its funds on the development of the Strategic Air Command, greatly reducing its tactical and defence units. In doing this the USAF was merely following its natural vocation. The concept of long-distance air operations is quite natural when there are three oceans, in one direction or another, between departure bases and targets. This long-distance action has been—and doubtless still

Western Europe's defence makes the coordination of all industrial forces imperative. The pictures show de Havilland "Vampire" jet fighters in production at the plant of SNCA du Sud-Est (left) and Gloster "Meteors" at the Fokker factory (right).

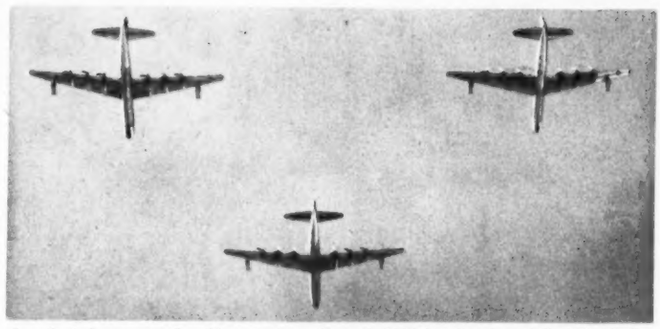


is—of paramount importance in maintaining the balance of power. But it also called for technical developments which are, needless to say, better adapted to American than to European needs. For a long time American fighters were designed for escort duties rather than for interception close to home. Thanks to the conditions under which it operates, the strategic air arm is spared many of the restrictions which still paralyze closer-range operations. In the former case the problem of ensuring continuous operations does not arise. In the second it has not yet been solved. If it is accepted that the air arm should play the part of destructive filter capable of so reducing the enemy's war potential that those land forces which get through are at least no more than equal in strength to the home divisions, there can be no let-up in close-range air operations. This has undoubtedly been continental Europe's task in the air, but it so happened that the need existed here without the technical equipment to satisfy it, whilst their equipment is closer to existing on the other side of the Atlantic, where the need would appear to be less pressing.

The same applies to the effects of differences in climate. Seen from a distance of several thousand miles the strategic, or even psychological, importance of a given geographical region is not the same as when seen from close quarters. The scale is far too different. A lull necessitated by weather conditions that are unfavourable to air operations may appear from a distance to be of as small importance as the withdrawal of a small ground squad. Its repercussions on the actual theatre of operations are quite different. It is therefore natural that at a distance the weather factor should be regarded merely as causing a temporary immobilization of the air arm. It is equally natural that reactions should be quite different when the question of the permanency of air operations is seen from closer quarters. These considerations must therefore determine the performance to be demanded of the flying equipment, the direction to be taken by research and development, and the composition and armament of the air units.

Differing widely in their technical aspects—and, as we have just seen, not always complementary—the Atlantic air resources are also different in their general conception. The wealth of certain countries permits of a sort of aeronautical luxury which not all can follow. That all should have the best and the most efficient of operational standards is obviously highly desirable. But this is difficult to achieve when it pre-supposes a levelling of the national standards of living.

Whether we consider manpower reserves or armament industry, we find the same disparity. Europe must count on its reserves, America thinks rather in terms of units formed in peacetime, particularly when a possible theatre of operations is under discussion. The tendency is naturally to form an expeditionary corps similar to that which began disembarking on June 6th, 1944, and which, completely equipped from the beginning, can operate independently without other support than supplies from the rear, i.e., from across the Atlantic. Within a certain measure, though to a smaller extent than the ground forces, the European air forces must base both their initial availability and the relative continuity of their operations on their reserves.



America's long-range bombing strategy (Convair B-36 bombers) contributed substantially to maintaining the world's balance of power.

Fighting on stock-piles

In the matter of armament production, the two industries have scarcely anything in common. Under cold war conditions American industrial mobilization aims at assembling resources for possible future mass production. Its task is to create a production machine sufficiently powerful to meet suddenly increased requirements, while remaining of secondary importance in the normal economic and industrial life of the country. This is an ideal that is difficult to achieve, but which the United States are trying to approach. Running at reduced tempo in peacetime, the production machine must be capable of turning out at a leisurely rate the equipment required and of ensuring its maintenance, without reduction in activity following on the period of maintenance causing excessive repercussions. Increasing its tempo if tension grows, it must reach its maximum power as quickly as possible after the outbreak of a general war.

In Europe, circumstances do not permit of such planning. Firstly, the production machine is not of the same dimensions. Secondly, it seems difficult to defend. It is even problematic whether it can be defended at all effectively, so that the question arises whether it would not be better to immobilize it and eliminate the need to try and protect it from air attack. Thus, acting under the very opposite conditions to the American armament industry, the European industries should produce actively during the cold war to build up the stocks required for the early phases of hostilities. Then, immobilized in the event of outright war, they would be supported by the American industry, which is theoretically less vulnerable to attack and practically better fitted to the scale of requirements. European industrial mobilization would therefore take place outside Europe. In spite of their differences, the two sources of equipment would thus be complementary, both in space and in time. This is one possible way of organizing Atlantic production resources. Admittedly, it is sufficiently revolutionary to require long study and extensive consultation before it can be put into effect.

The USAF has traditionally given preference to long-range fighters (left : Northrop F-89 "Scorpion") ; only recently it has begun to place emphasis on the production of all-weather interceptors (left : Lockheed F-94C "Starfire").

(I) Political and Military Structure of the North Atlantic Treaty Organization

North Atlantic Council
(Ministers)

Council of Deputies
(Deputies of Ministers)
London
International Staff and Information Service

Military Committee
of NATO
Chiefs of Staff

Executive Bureau
(Paris)

Defence Production Board
(London)

Financial and Economic Board
(Paris)

Planning Board for Ocean Shipping

Advisory Group for Aeronautical Research and Development
AGARD
(Paris)

Military Representatives Committee
(Washington)

Military Standing Group
USA, UK, France
(Washington)

Military Standardization Agency
(London)

Canada-US Regional Planning Group
CUSRPG
Washington)

Supreme Allied Commander, Atlantic
SACLANT
(As yet no detailed structure)
Admiral William M. Fechteler (US)

Supreme Allied Commander, Europe
SACEUR
General Matthew Bunker Ridgway, (Fontainebleau)

Supreme Headquarters Allied Powers, Europe
SHAPE
(Fontainebleau)

Other Commands to be established
e.g., Middle East Command

* * *

(II) European Staff and Command Structure of NATO

Military Standing Group
(USA, UK, France)
Washington
Lt. Gen. Paul Ely (Fr.), Chairman,
Air Chief Marshal Sir William Elliot (UK)
General Omar N. Bradley (USA)

Supreme Commander, Europe
SACEUR
General Matthew Bunker Ridgway (USA)

National Military Representatives at SHAPE from :
Belgium
Canada
Denmark
France
Greece
Italy
Luxembourg
Netherlands
Norway
Portugal
Turkey
United Kingdom
USA

Deputy (Air)
Air Chief Marshal Sir Hugh Saunders (UK)

Deputy Supreme Commander, Europe
DEPSAC
Field-Marshal Viscount Montgomery (UK)

Deputy (Naval)
Vice-Admiral Lemonnier (Fr.)

Supreme Headquarters Allied Powers Europe
SHAPE
(Marly)
Chief of Staff : General Alfred Gruenther (USA)

Special Assistant for Liaison with National Military Representatives
Brig.-Gen. Biddle (USA)

Chief of Public Information
Brig.-Gen. Lanham (USA)

Chief of Staff Secretariat
Col. Wood (USA)

Special Assistant to C. o. S.
Maj.-Gen. Schuyler (USA)

Assistant Chief of Staff, Plans and Operations,
Air Chief Marshal E. C. Hudleston (UK)

Assistant Chief of Staff, Administration and Logistics,
General Condraux (Fr.)

Adjutant-General

Budget and Finance Division

Intelligence Division

Logistics Division

Personnel and Administration Division

Plans, Policy, Operations Division

Training Division

Communications Division

Allied Forces
NORTHERN EUROPE
C.-in-C.: Admiral Sir Patrick Brind (UK)
CINCNORTH
Oslo

Allied Forces
CENTRAL EUROPE
C.-in-C.: General M. B. Ridgway (USA)
CINCCENT
Fontainebleau

Allied Forces
SOUTHERN EUROPE
C.-in-C.: Admiral Robert B. Carney (USA)
CINCSOUTH
Naples

Allied Air Forces Northern Europe
Maj.-Gen. Warren G. Carter (USA)
Oslo

Allied Land Forces Norway
Lt.-Gen. von Taugen-Hansteen (Norway)
Oslo

Allied Land Forces Denmark
Lt.-Gen. Moeller (Denmark)
Copenhagen

Allied Naval Forces Northern Europe
Admiral Sir Patrick Brind (UK)
Oslo

Allied Air Forces Central Europe
General Lauris Norstad (USA)
Fontainebleau

Allied Land Forces, Central Europe
Field-Marshal A. Juin (Fr.)
Fontainebleau

Flag Officer, Central Europe,
Vice-Admiral Jaujard (Fr.)
Fontainebleau

Allied Air Forces, Southern Europe,
Maj.-Gen. David M. Schlatter (USA)
Naples

Allied Land Forces, Southern Europe
Lt.-Gen. Enrico Frattini (It.)
Verona

Turkish NATO Forces

Greek NATO Forces

Allied Naval Forces Southern Europe
Admiral Robert B. Carney (USA)
Naples

National Contributions to NATO Air Forces in Europe :
Total : 3840 Aircraft

Aircraft Types	Number of Aircraft	
Vampires, Venoms, Meteors, Canberras	1300	*Royal Air Force (NATO contribution)*
Vampires, Mistrals, Ouragans, F-84 Thunderjets	560	*French Air Force (NATO contribution)*
Meteors, F-84 Thunderjets, Mosquitos	200	*Belgian Air Force (NATO contribution)*
Meteors, F-84 Thunderjets	200	*Netherlands Air Force*

As the organizational integration of the "European Army" of the future (agreement of May 9, 1952, between France, Benelux countries, Italy, Germany) has not definitely been settled yet, no mention of it has been made in Chart II.

———— non-permanent

– – – – permanent

	Number of Aircraft	Aircraft Types
Danish Air Force	200	Meteors, F-84 Thunderjets
Norwegian Air Force	120	Vampires, F-84 Thunderjets
Italian Air Force (NATO contribution)	200	Vampires, F-84 Thunderjets
USAF in Europe	1000	F-86 Sabres, B-50 Superfortresses, C-119 Packets, F-84 Thunderjets
Royal Canadian Air Force (NATO contribution)	60	F-86 Sabres

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In times of "cold war" America's industrial mobilization has aimed at creating the capacity for mass production in an emergency. *Left:* North American F-86 in production in the USA; *right,* in Canada.

Air mosaic super-imposed on territorial mosaic

If the integration of the Old World and the New seems a complex affair, the European air problem itself has not yet found a rational solution. The task is so new, so revolutionary even, that the difficulties to be overcome are legion. The European territorial mosaic has its internal differences which must be composed.

All countries demand the best of flying equipment, the most advanced and the most efficient, but those that can pay the price are rare. The *obvious solution is for research and production resources to be pooled* and for all to make the best equipment in each category. In practice such a policy comes up against many obstacles, not all of them of purely sentimental nature. In theory it would appear to be quite possible to agree on the allocation to each country of a given sector of aircraft production activity to correspond where possible, to the country's particular aeronautical talents. In fact, such a plan would be possible if a clean sweep were made of the past and sufficient resources were available at the start to pay the price of such an upheaval.

It would also appear to be logical that there should ultimately be joint discussion of air equipment programmes and that a choice should be made each year among all the national prototypes. But, here too, the military community is still too young for the differing national attitudes to be co-ordinated so rapidly. Everything so far is being done as if the present peril had necessitated no more than a temporary grouping of resources and as if conditions had to be retained for a return to the previous *status quo.*

The Brussels Pact and later the North Atlantic Treaty should have made themselves felt in the field of air equipment and have led the Western world towards standardization and unification of types. In fact these agreements have tended rather to produce a greater diversity in research and production than to encourage unification. The general increase in military expenditure has enabled new designs to be produced which, distributed on a strictly national scale, have combined with older ones to produce too vast a range of equipment, with considerable overlapping. In a review of the Atlantic organization's combat equipment, a British journal enumerated some 40 different types for fighter, light and heavy bomber and naval air missions alone. If we add the sub-categories resulting from the installation of different power plant in these types, and the transport and training aircraft, we get nearly a hundred different types of flying equipment.

To judge by the number of new projects already known, this figure will continue to increase during the coming years. What will be the reaction of a future commander-in-chief of an air force comprising less than 6,000 aircraft of 100 different technical and operational variants ? If we are to continue on the present path it is incontestable that the European air arm, compared with the standards achieved by the two great air powers, will be costly to produce and to maintain and complicated to operate.

In spite of its technical backwardness in certain fields, and its vulnerability to attack, the value of Western Europe's aircraft industry is not under discussion. In our opinion, however, it will be if, once it draws level technically, it ends up with such a diversity of equipment and

British night fighters getting ready for take-off.

American equipment—from aircraft to crash helmet. Pilots of No. 5 Fighter-Bomber Squadron, Italian Air Force (Republic F-84 "Thunderjets").

NATO Planners (May 1952). Front row, left to right : *Members of the Military Standing Group*, Washington : Vice-Admiral Arthur C. Davis, Deputy US Representative ; Lt.-Gen. Paul Ely, France, Chairman of the Group ; General Matthew B. Ridgway, SACEUR (not a member of the Group) ; Admiral Sir Cyril Douglas-Pennant, Acting U.K. Representative ; Brigadier Richard H. Barry, U.K., Director of the Group. — Back row, left to right : *Military Representatives Committee* (Washington) : Major-Gen. Marc A. Pholien, Belgium ; Air Vice-Marshal Hugh Campbell, Canada ; Rear-Admiral Svend Ramlan-Hansen, Denmark ; Brigadier Gregory Th. Ketseas, Greece ; Lieut.-Gen. Enrico Frattini, Italy (now Commander, Allied Land Forces, Southern Europe) ; Rear-Admiral Jonkheer H. A. van Foreest, Netherlands ; Commander R.M. Lars, Norway ; Brigadier-General Angelo de A. Ferreira, Portugal ; Rear-Admiral Aziz Ulusan, Turkey.

can thus turn out only small quantities. The quality of certain of its prototypes has justified its reconstruction ; its unification will assure its future.

The obligation is both operational and financial. It applies to the aviation industry as well as to the actual air arm. The foundations on which air strength is based must be paid for, one way or another. Whether it is used for 1,000 or 10,000 aircraft, the radar detection and control network costs about the same and requires the same personnel. A large wind tunnel costs the same to construct and to maintain whether it tests ten or a hundred models a year. No European country can nowadays afford the full sums required for modern research. On the other hand, the whole community can pay for such equipment provided it is supported and used by all.

A similar grouping is taking place on the atomic level and being mapped out for the giant computing machines. Doubtless it will also be achieved shortly in the field of aviation, since its advantages are obvious. Indeed it is not very likely that American aid will continue to be given to increase national research and testing equipment when there are super-abundant facilities already in existence and all that is necessary is to lower technical barriers so that all can make use of them.

The reinforcement of specifically European forces with units from across the Atlantic sets other problems which are both simpler and

Air Chief Marshal Sir Hugh Saunders, Deputy SACEUR (Air), being welcomed at Rome-Ciampino Airport by General Aldo Urbani, Chief of the Italian Air Staff.

yet more difficult to settle. Here, too, the contradiction between the different attitudes of the "Europeans" is clear. It might be said, somewhat crudely, that being anxious not to have to bear the human brunt of defending Europe unaided, they have asked for the dispatch of forces from the other side of the Atlantic, only to find now that their presence is a burden. Admittedly, it is difficult for the world to get used to the present conflict. In times of cold war which it mistakes for a time of peace, the world is less willing to agree to sacrifices which it would regard as natural during a conventional war. The solution rests in the development and strengthening of the European air forces, not so much to replace the Allied units, whose presence will depend on the enemy's strength, but to make of the Western defence organization a true inter-Allied partnership, with each partner making a worthy contribution. It is obvious that, in view of their rôle in history and the sacrifices they have already made, the nations of Europe will be reluctant to accept a system of indirect defence—to which they would make but a symbolic contribution—particularly as such defence would have to be applied from their territory.

Here is yet another reason why Europe must strive for technical and operational efficiency.

Begin with the air

This somewhat summary review of the obstacles standing in the way of the development of the Western air arm forms a large share of the contradictions and limitations of the European position. Within Europe itself the aim must be to increase the value obtained for the air appropriations, since no substantial rise in the latter can be expected. Where the production of air armaments is concerned, this increase in financial efficiency would be accompanied by greater operational efficiency if :

- the facilities already existing were placed at the disposal of all, regardless of administrative and political frontiers ;
- "national vocations" were studied and development sectors allocated to each country according to its military responsibilities, capabilities and technical experience ;
- design programmes were worked out in common, and the objectives to be reached clearly set forth, making allowance for the total sum of knowledge and the resources available within the community ;
- prototypes were compared and selected by common accord, for their performance and their conditions of manufacture ;
- production were distributed among the different factories in Western Europe according to their production capacity ;
- maintenance and repair were carried out according to an overall plan similar to the above-mentioned development and production plans.

However difficult of realization they may seem, these proposals are not revolutionary. They merely aim at creating here what already exists, in differing degree, in the United States and the Soviet Union. It is difficult to see how Europe can otherwise overcome the disadvantages inherent in its present political division. But it is obvious that no such integration is possible unless it is supported intellectually and materially by the United States. It is clear that the aim of American military aid to Europe is to contribute to the creation of a force which Europe will then be able to support from its own resources. To do anything else would necessitate such aid becoming permanent and to act contrary to the aims pursued on both sides of the Atlantic. Since the air problem is decisive, and because it is perhaps easier to define than that of the land and sea forces, it should be tackled first. It is for this reason that it may become one of the instruments of European unity.

The British Commonwealth Relation to NATO and SHAPE

BY CAPTAIN NORMAN MACMILLAN, M.C., A.F.C.

Britain's Strategic Outlook

The attitude of Britain—a pillar of the North Atlantic Pact—towards NATO and SHAPE is unquestionably related to the country's historical tradition. She has always been associated with Western and Mediterranean Europe, but has never been tied to either for 1800 years. The Norman invasion of England created not a dependency, but a new Kingdom. The earlier invasions by Celts, Saxons, Jutes, Danes created a complex of small British kingdoms. Only the Romans made part of Britain a province of their great Empire ; but the people they fought and overcame were the Celts. The British of today are descendants of Celts, Romans, Saxons, Jutes, Danes, French and quite a sprinkling of other European nationalities ; they have no special tie to any one part

Air Chief Marshal Sir Hugh W. L. Saunders, Deputy Supreme Commander Europe (Air).

of the European mainland ; although they are essentially Western Europeans themselves, they are insular, an outpost of Europe, the stepping-stone historically and geographically between Europe and North America, as Spain and Portugal were the stepping-off points for Central and Southern America.

The wide-flung units of the British Commonwealth of Nations enhances that conception. No combination of peoples in the world is similar, none has so greatly separated parts, and none is held together in the same way. So, when the British say they have responsibilities outside Europe which prevent them from joining the European Community, they are voicing a truth which they believe to be spiritual, historical and traditional, and that by following their rôle of independent action they are treading familiar paths, and serving the common good of mankind.

I do not believe they can be accused of selfishness in following this policy. Although some European nations consider that their own security may demand a greater integration of British effort with their own, Britain may well point out that in the past the security of oppressed Europe was more often guaranteed by the action of the British Navy in far distant battles than by any other military strategy.

In a word, militarily, the difference between such purely European outlook and the British viewpoint is precisely the difference between the tactical and the strategic outlook.

I think that Britain regards the position in Western Europe as a tactical field in a world strategic picture. If she were to sink everything into Western Europe, she would be committed to a tactical rôle. Thus, Britain sees a world strategic situation, and her contribution to NATO and SHAPE is framed within her estimate of that overall situation.

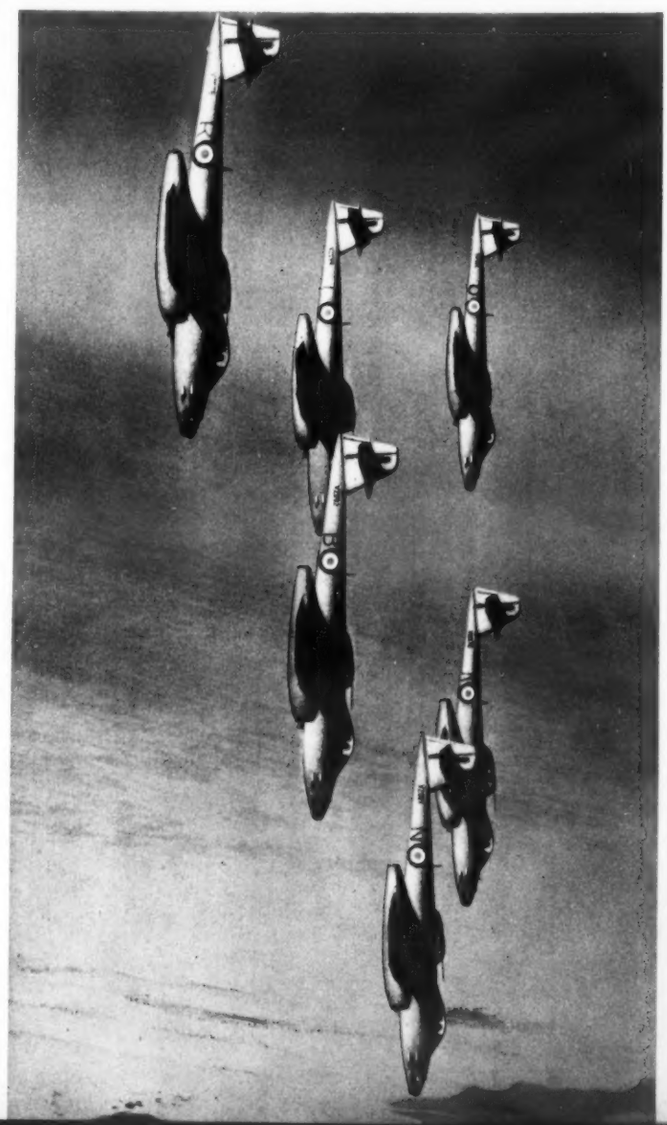
So at the present time, we see the air power of Britain divided into certain fields of tactical employment or deployment, each and all of which taken together comprise her total contribution to world security against the menace that confronts Western Europe. Britain's air power is deployed on her Home Front, in Western Europe, in the Middle East, and in the Far East. Each portion of that force is concerned in the same overall strategic plan, just as certainly as the British Mediterranean Fleet and the Home Fleet were concerned in the same strategic plan in the times of Louis XIV and XV of France.

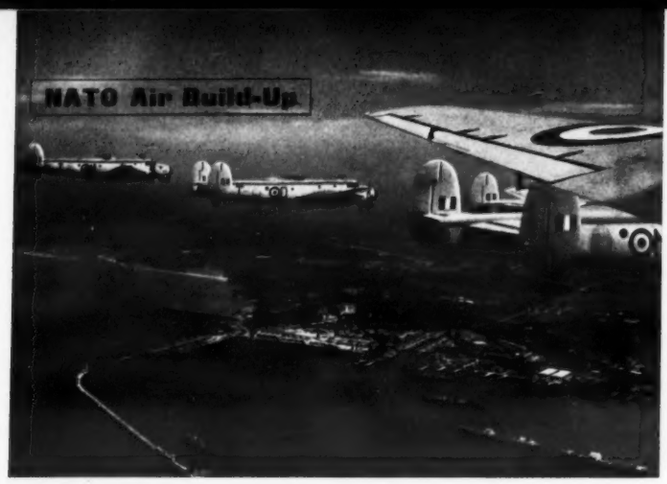
Practical contribution

The relationship of Western European defence in the overall strategic picture as seen in Britain can be visualized from the contribution which the RAF has made to the tactical situation in Western Europe. This takes the form of what was formerly the British Air Forces of Occupation in Germany, now renamed the 2nd Allied Tactical Air Force. It is called "Allied" because Netherlands and Belgian squadrons are incorporated in it, and Netherlands and Belgian officers work in the British Headquarters. This force forms part of SHAPE Command, is integrated by Supreme Allied Command, Europe (SACEUR), of which Air Chief Marshal Sir Hugh Saunders is the Deputy (Air), at SHAPE Headquarters, and is one of the two tactical air forces in the Allied Air Force Central Europe Command.

The 2nd TAAF is to be a mobile force, with almost everything but the runways on wheels, and its planned expansion is greater than that of

British air forces are stationed at nerve centres in various parts of the British sphere of influence. These are Gloster "Meteor" reconnaissance fighters performing aerobatics in the Suez Canal Zone.





Avro "Shackleton" long-range patrol bombers are standard equipment of RAF Coastal Command. Here some of them are flying over Colombo Harbour, Ceylon.

any other single RAF Command. It is now in course of re-equipping with de Havilland "Venom" fighter-bombers, and is also receiving the radar-equipped Gloster-Armstrong Whitworth NF.11 night fighter. Other RAF squadrons will be re-equipped with Canadian-built F-86 "Sabres."

By the end of 1952 there should be 4,000 first-line aircraft in the NATO force, and it is probable that rather more than one-third of this number will be provided, manned and maintained and commanded by the RAF. This RAF contribution to the whole effort is a major one. The one third contribution by the RAF includes not only all RAF aircraft in 2nd TAAF first line, but the Canberra force which is to be placed under the direct control of SACEUR. The RAF is thus providing a strategico-tactical jet bomber without equal today to the direct defence of Western Europe. In addition, RAF medium bombers of Bomber Command would execute missions for SACEUR when a case was made for priority use for them.

Canada, too

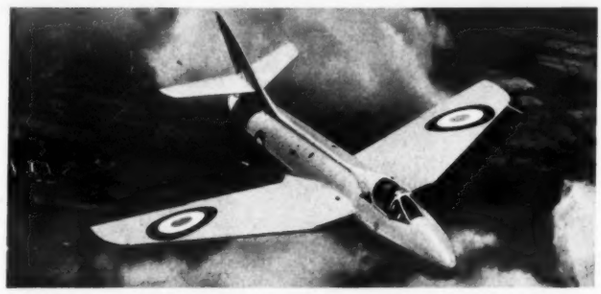
Canada is the only other member of the British Commonwealth of Nations to make a direct contribution to the air defence of Western Europe. The RCAF is to send 11 squadrons of Canadian-built "Sabre" fighters to Europe. The first wing of three squadrons has arrived at RAF Station North Luffenham in the United Kingdom, and it is expected that they will go to the Continent to join the *4th TAAF* (which includes the U.S. 12th A.F. and three French squadrons) soon.

These two Allied Tactical Air Forces are to be integrated closely so that they will fight as one team, but in accordance with the Army formations they support.

Deliveries of the RAF's second patrol bomber, the Lockheed P2V-5 "Neptune," have begun under America's Mutual Defence Assistance Programme.

"Super-P"

"Super-Priority" has been ordered for the production of these six British combat aircraft



HAWKER P.1067 "HUNTER": Single-seater interceptor powered by a Rolls-Royce "Avon" jet delivering a static thrust of 6,500 lbs.-plus; top speed, 650 m.p.h.-plus.

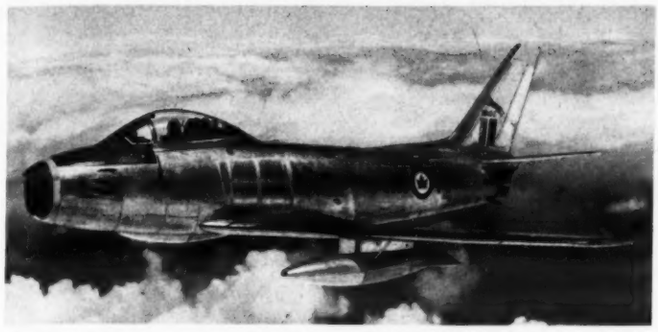
VICKERS-SUPERMARINE "SWIFT": Single-seater interceptor with 6,500 lbs.-plus Rolls-Royce "Avon"; top speed, 650-700 m.p.h.

ENGLISH ELECTRIC "CANBERRA 2": Light bomber and long-range reconnaissance aircraft with two 6,500 lbs. Rolls-Royce "Avons"; top speed about 600 m.p.h.

VICKERS-ARMSTRONGS 660 "VALIANT 1": Medium bomber (A-bomb carrier) with four Rolls-Royce "Avons" (each of more than 6,500 lbs. static thrust); top speed approximately 620 m.p.h.

GLOSTER GA-5: Delta-wing twin-engined all-weather fighter; two Armstrong-Siddeley "Sapphire" jets of more than 8,300 lbs. static thrust; top speed 650-700 m.p.h.

FAIREY 17 "GANNET 1": Anti-submarine aircraft powered with an Armstrong-Siddeley "Double Mamba" propeller turbine of about 3,000 shaft horsepower; top speed approximately 300 m.p.h.



Canada is stationing eleven jet fighter squadrons in Europe, to form part of the 4th TAAF. They are equipped with Canadair-built F-86 "Sabres."

Thus, although Britain has not joined the European Defence Community, her contribution to the defence of that community represents a powerful part of it, and in the air force already deployed, and its plans for expansion, exceeds the total effort of all the Western European nations combined.

RAF Coastal Command

One other RAF Command comes directly under NATO planning. This is the Coastal Command, which will come under Supreme Allied Command, Atlantic (SACLANT) in war, but not in peace. At present re-equipping with Avro "Shackleton" and Lockheed "Neptune" aircraft in replacement of "Lancasters," Coastal Command will operate in the East Atlantic sub-command. This Command is currently organized in two Groups, Nos. 18 and 19, with outposts in Northern Ireland and Gibraltar as lesser commands. No. 18 Group Headquarters stands on the north-east coastline of the United Kingdom, and No. 19 on the South-West. They are thus disposed to guard the North Sea and Northern Approaches and the West Channel and the South-Western Approaches. To fit them for their duties, exercises are planned to simulate the conditions which would apply in the event of war. One such exercise was held in June this year under the code-name "Castanets" for the purpose of testing the defences against submarine activities in the West Channel and South-Western Approaches.

This exercise was held under another international command, called the *Channel Command,* which is subsidiary to the designated East Atlantic Command, and which, in fact, already has been brought into being under the Chiefs of Naval Staff of the United Kingdom, France, Belgium and the Netherlands; its function is to guard the maritime communications between the East Atlantic Command and the Western European seaboard opposite the south coast of England.

The second British standard naval jet fighter—the Hawker "Sea Hawk."

The first big exercise of SACLANT will take place in September under the code-name "Mainbrace" and it will be the biggest air/sea exercise so far held under NATO.

The Royal Navy today has 14 aircraft carriers, and 8 more are under construction. A large proportion of this strength will contribute to NATO's Atlantic forces. Picture shows the 13,190-ton "Ocean" Light Fleet Carrier of the "Colossus" Class, completed on June 30th, 1945.

Naval contribution

The commands of the Royal Navy corresponding to those mentioned for the RAF have also been earmarked for SACLANT. These will therefore contribute the portion of naval air power contained within them as ship-borne aircraft. It is impossible to state precisely how many carriers may be thus allocated, as the strategic situation varies, and the mobility of carriers enables them to move accordingly. But a considerable proportion of the R.N. present strength of 14 carriers of all classes would be so employed ; this strength is being raised by 8 new carriers under construction. Canada can contribute one aircraft carrier to the combined force.

*

Australia is not committed to assist Western Europe or Atlantic defence. Her furthest commitment is in the Suez Canal Zone, where she has placed a RAAF Wing at the disposal of the RAF. British air forces in Malta, Cyprus, Aden, the Canal Zone, Iraq and East Africa (with South African Air Force wartime reinforcement) stand outside the Western European defence zone, but it is apparent to anyone examining the world strategic situation that in maintaining her defence commitments in these areas Britain is in fact contributing strategically to the defence of Western Europe in accordance with the traditional rôle referred to at the beginning of this article. Moreover, that rôle might well prove to be of immense importance to Western Europe, if war on a major scale should come.

NATO's Air Force and Italy

BY BRIGADIER-GENERAL CARLO UNIA, OF THE ITALIAN AIR FORCE STAFF

EDITOR'S NOTE : *Italy began her active participation in the post-war defence of the West on April 4th, 1949, when she became a signatory of the North Atlantic Pact in Washington. Since that date the war-devastated country has furnished an impressive effort to make an effective contribution to Western defensive power. Assisted by American military aid, it is today engaged in building up its defensive forces beyond the limits set under the Peace Treaty it had signed with twenty ex-enemy countries—limitations which were denounced by the Italian Government at the end of last year. In the following article* General Unia, *of the Italian Air Force Staff, describes Italy's efforts to expand its air force in order to make it a powerful component of the West's air power. It is to be regretted that his observations must be confined to generalities and cannot accurately reflect the present state of Italian air preparedness.*

Reconstruction of Italy's military air power started in 1947 under the most unfavourable conditions. These were the result of the destruction of the Air Force's ground facilities during the war, the dispersal of its personnel, and the obsolescence of its air fleet, which consisted of a motley collection of Italian, British and American war relics.

The peace treaty with the United Nations fixed an absolute ceiling for Italy's air strength at 25,000 men and 350 aircraft, of which only 200 were to be armed for defensive purposes. Other restrictions were imposed on air operations.

Italy's Air Force is being re-equipped with American help. The picture shows part of the ceremony at Brindisi airport on May 10th, 1952, on the occasion of the first deliveries of Republic F-84E "Thunderjet" fighter-bombers to Italy.

These limitations were gradually overcome as a result of the new military obligations which Italy assumed after it had joined the North Atlantic Pact.

Yet, despite inadequate financial resources, the Italian Air Force has succeeded in bringing about a considerable intensification of recruiting and all phases of training.

Training

The flying training organization of the Italian Air Force is concentrated in the south of Italy and the Italian islands. Engineering personnel and other specialists are trained in every part of the peninsula, with the exception of the extreme Northeast frontier region. All training has been intensified to meet the gradual increase in the requirements resulting from the tasks assigned to the Italian Air Force by NATO. Conversion of aircrews to the latest jet-propelled aircraft, training of personnel in the use of modern anti-aircraft defence equipment, and instruction of officers of the three Services in the field of close air support must all proceed apace with the training of new recruits.

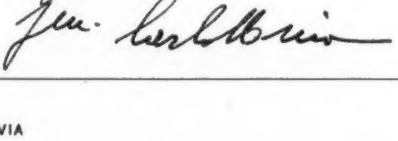
Other problems to be coped with are the standardization of ground facilities, communications, flying aids and flying control.

Ground facilities

When it is considered that at the end of the second World War nearly all Italian air bases were destroyed, the size of the effort needed in this field is obvious. At the present time, the Italian Air Force has a substantial number of air bases with hard-surface runways and complete equipment. Not all of them are up to SHAPE's standards, but they are serviceable and undergoing improvement. Several entirely new bases conforming to NATO standards are nearly completed, and the progressive improvement of the others to the same level is scheduled to be completed by 1954.

Since the European integrated defence plans specify first of all the provision of air support for all of NATO's land divisions, a major effort has been devoted to the ground organization in the north-eastern sector of the country, where the command of the Allied land forces, Southern Europe, is located.

Brigadier-General Carlo Unia was born in Turin in 1906. He graduated from the Turin Polytechnic and the Air Force College and was commissioned as a pilot and combat observer in 1928. During the war he commanded torpedo-bomber squadrons. After Italy's armistice with the Allies in 1943, General Unia was captured by the Germans and sentenced to death for his refusal to cooperate with them. While awaiting his execution in a Polish prison he escaped. In the course of his career outside his country he has been an instructor to China's Nationalist Air Force, Air Attaché in Lisbon, Washington and Ottawa, and he was the first Italian military representative with NATO following Italy's signature of the Pact. At present he is Director of Operations and Training on the Italian Air Staff in Rome.



First-line organization

Italy's operational units at present are composed of interceptor, ground support and tactical reconnaissance fighter squadrons; transport squadrons and liaison squadrons; anti-submarine squadrons; light artillery spotting units; and air/sea rescue units equipped with seaplanes and amphibians.

Some of the fighter units, now in the process of conversion to jet aircraft, form the 56th Tactical Air Force, which for its operational use depends on the Allied Air Command for Southern Europe, with headquarters in Florence. These are now being strengthened. Other fighter units are assigned to the country's own air defences, but in emergencies they can also be allocated to the supra-national air units.

To meet its obligations under NATO, the Italian Air Force is now in the process of trebling its operational strength and of converting to jets, with the exception of the transport units. Under this programme a twelve-fold increase in the number of jet pilots and the trebling of Air Force specialists is needed.

Pilots of No. 5 Fighter Squadron, Italian Air Force. Equipment delivered with the "Thunderjets" seems to include the crash helmets, still marked with USAF insignia.

Equipment

As regards equipment, the tactical air units are now receiving Republic F-84 "Thunderjet" aircraft furnished by the USA under the Mutual Defense Assistance Program; interceptor units operate D.H. "Vampire" fighters, shortly to be supplemented by "Venoms." Transport units are still equipped with Fiat G.212 and SIAI Marchetti 82 aircraft, liaison units with Beechcraft UC-45 twin-engined light transports, anti-submarine squadrons with single-engined Curtiss "Helldivers," and air/sea rescue units with Piaggio P.136 amphibians and obsolescent Cant. Z.506 seaplanes. The flying schools use Macchi trainers, the Italian version of the Fokker S.11 "Instructor," Piaggio 148S, AT-6 "Texans" imported under the Mutual Defense Assistance Programm, Ambrosini S.7's, Fiat G.46's and G.59's, and in the near future Republic F-47 "Thunderbolts" and North American F-51 "Mustangs" withdrawn from first-line squadrons re-equipped with "Thunderjets" and "Vampires."

Industry

Industrially speaking, Italy today can make a substantial contribution towards fulfilling NATO's needs.

Already now, "Thunderjet" airframe maintenance and overhaul is being carried out by Officine di Pomigliano d'Arco, Naples, and Allison jets are being handled by Fiat in Turin. Fiat and Aeronautica Macchi are building "Vampire" interceptors and will shortly start production of the "Venom." Aeronautica Macchi and Industrie Meccaniche Aeronautiche Meridionali are making the Fokker S.11

An instructor (second from left) and his pupils at NAVAR. Smoking permitted on the flight line ?

"Instructor" trainer under licence under the name Macchi 416. Fiat and Alfa Romeo are turning out D.H. "Ghost" jet engines, some of them for other NATO countries.

Furthermore, under the expanded American programme for so-called "offshore" procurement the Italian aircraft industry can supply aeronautical equipment in a steady stream. Italian plants have already received American contracts for the manufacture of spare parts for the F-84 "Thunderjet" fighter and its Allison engine, and others are expected. Fiat's jet fighter and trainer programme, as exemplified in the G.80

Italian mechanics swarming over their new "Thunderjets."

trainer and its derivatives, the G.81 and the G.82, seems to have aroused particular interest in the USA. Close liaison has been established with the French and British aircraft industries.

In addition, the Italian electronics industry, which has an international reputation, is engaged in large-scale production for the Italian Air Force and the anti-aircraft defences and will shortly receive contracts also for the Atlantic community.

In conclusion it may be stated that the Italian Air Force has made very substantial progress—although it is still grappling with obvious difficulties—in every sector of fundamental importance: personnel, bases, operational squadrons, equipment, cooperation with the other Services, assistance to the industry in the design of aircraft and engines. It is approaching the time when it can play its full rôle within the European Defence Community.

Germany in the Western European Defence System

On the outskirts of Bonn, the capital of the West German Federal Republic, there are a number of small old-fashioned houses and some temporary buildings under construction, with no indication of the use to which they are to be put. Most of these premises are empty, still awaiting their occupants, the *Blank Office*, a section which appears to be very near to the head and heart of Chancellor Adenauer and which is led by Herr Theodor Blank. The Blank Office is the nucleus of a future West German defence ministry.

In one point only does it follow the "old Prussian tradition"; it is silent. True, it has every reason to be so at the moment, since it is still very much in the air in every respect, practically and legally. It is so far a ministry without minister, a general staff without chief, a future head organization of the Republic's armed forces without personnel or power to give orders.

The premises at present house only a relatively small number of young staff officers and engineers, who draw up plans and negotiate with foreign countries.

General Heusinger is being unanimously named as future head of the armed forces, with General Speidel, a former staff chief of Rommel's, being mentioned as future chief of the general staff. As the tactical air force will doubtless play an important part in Western Germany—within the framework of the European Army—the names of two leading personalities may be mentioned, with all due reserve, for its command: General Meister, formerly for a short time Chief of the Luftwaffe's Operations Staff and towards the end of the war Chief of the difficult Personnel Division, is tipped as future commander of this branch of the forces; and Colonel A. Eschenauer (an article by whom appeared in the July issue of Interavia), is mentioned as his future chief of staff. Meanwhile very little is being said about these men, as they are still civilian officials and are still to be addressed as "Herr Dr."

There is only one little indication that things are moving. The above-mentioned gentlemen, and others, from time to time pay visits to the Palais de Chaillot, in Paris, the future administrative headquarters of the European Defence Community. And evidence that plans are being made and that the "general staff" is thinking of the future is provided by the fact that a few weeks ago the Deutsche Versuchsanstalt für Luftfahrt (German Aeronautical Research Institute), an article on which appears elsewhere in this issue, was revived. This revival is of interest not only to German research, or even to the remains of the German aircraft industry, but also above all to the future German general staff. Links already appear to exist between general staff, industry and aeronautical research.

However the whole affair of the Blank Office may develop, new ground has to be broken where the equipment and technical control of the future German tactical air force are concerned—following a break of at least seven or eight years. Considerable efforts must be made on the German side, to become familiar with the new equipment, and its handling and repair. For this an industry is required, and an industry needs research.

Another difficult problem is that of language differences in the future European contingents. Even if all main orders are given in a single language (English), local languages will persist, and only if the methods of communicating orders are laid down in good time can misunderstandings and errors be avoided. To work out these command details will thus be one of the main tasks of the future command of the NATO air forces.

These are some of the complications and difficulties which confront the nucleus of a West German defence ministry, a West German army or a West German tactical air force. But there are still other difficulties...

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Properly speaking the future German armed force will, to begin with, have only indirect connections with the Atlantic forces. It is to form part of the European Army to be set up by the end of 1954, and is based on the *European Defence Community agreement*. This agreement was initialled in Paris on May 9th, 1952, by representatives of six European powers, France, Italy, Belgium, Holland, Luxembourg and Germany. At the signing there was a notable absence of the usual speeches, photographers, journalists, banquets and toasts. With good reason! The birth of the European Army is not an easy one. The European Defence Community treaty is to a certain degree an extension of the Brussels Pact of March 1948. But whereas the signatories to the Brussels Pact included Great Britain in addition to France and the Benelux countries, this time Britain is missing, and Germany has been taken in as new partner.

The Brussels Pact was still directed unequivocably against any rearmament of Germany. Article 7 states: "...the Council shall be immediately convened in order to permit the Parties to consult... with regard to the attitude to be adopted and the steps to be taken in case of a renewal by Germany of an aggressive policy..."

Since then there has been a fundamental change. Today efforts are being made to draw the West German Federal Republic into the community of Western Europe. As yet the outcome of the Parliamentary debates on the ratification of the European Defence Community is quite uncertain. The German Federal Council has postponed the ratification debates until late autumn, and the French National Assembly is showing an equal lack of enthusiasm. It almost seems as if each of the two parliaments were waiting for the other to decide first, before making any binding resolutions and accepting responsibility, in the eyes of its own people, for collaborating with its former enemy.

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In view of these difficulties and uncertainties it is understandable why no authentic figures are yet available for the strength of the future German air force. The West German Government's official bulletin, at the end of June, forecast that the peacetime strength of the German armed forces would be roughly 410,000 and the German contingent of the European Army about 310,000. As for the strength, organization and fleet of the German air force, there is nothing to be had at the moment but estimates. The only thing that is definite is that it will have only tactical units (fighters, fighter-bombers, light transports). The latest reports from Western Europe put the total strength of the European Army air forces at some 5,200 aircraft and the contribution of Germany's air forces at about 1,500 aircraft and 85,000 men.

From Newton's Note Book to Mammoth Research Organizations

AN INTERVIEW WITH PROFESSOR THEODORE VON KÁRMÁN,
CHAIRMAN, ADVISORY GROUP
FOR AERONAUTICAL RESEARCH AND DEVELOPMENT, NATO

The day of the private scientist in the engineering sciences has gone. Supersonic wind tunnels, turbine laboratories, mammoth cyclotrons . . . The equipment for modern research has gone far beyond the reach of the individual. In fact even many countries find present-day scientific equipment's astronomic costs prohibitive. Only big countries such as America can, by pinching and scraping, get together a complete research and development organization.

On the other hand efforts at achieving supra-national cooperation encounter considerable difficulties, such as military security regulations, fear of competition, petty national jealousies.

Nevertheless the call for a community effort is becoming louder and more urgent. Ultimately the success or failure of the Atlantic Organization depends not only on the military, but also on the technical and industrial cooperation of all the powers concerned.

We have asked *Professor Theodore von Kármán* for his opinion on these questions because we consider him to be the exemplification of a supra-national scientist.

Honorary doctor of seven universities in five different countries, Member of the Royal Society, the French Académie des Sciences, the American Academy of Arts and Sciences, the Academies of Rome, Turin, Madrid, his teaching duties have taken him to the leading universities and polytechnics in three continents. Germany, Belgium, the United States, Japan, China, India—there is scarcely a country which has not enjoyed at least guest lectures by Professor von Kármán. His advice has also been sought on the practical level by such firms as Junkers, Kawanishi, General Electric, Northrop, Aerojet . . . Aviation firms throughout the world have called upon him as consultant. The California Institute of Technology appointed him to head the Guggenheim Foundation, the U.S. Air Force made him chairman of its Scientific Advisory Board. Born in Hungary under the Danube monarchy, Kármán has written standard works on aerodynamics and hydrodynamics, statics, mechanics, etc., in Hungarian, German and English.

When we called on Professor von Kármán he had just packed his bags for flying visits to Paris, Madrid and the American West Coast. The following is the substance of our conversation :

What possibilities do you foresee for international cooperation in the field of aeronautical research ?

"I may perhaps disappoint you slightly. Nobody doubts that NATO's air power depends largely upon research facilities in the allied countries. It is no less obvious that the prospects of success—scientifically and economically speaking—are much greater if aeronautical research is not restricted to any single country, and if all make their contribution within the measure of their resources.

"Nevertheless, I confess that as a scientist I am a confirmed individualist. I simply cannot believe in the blessings of mammoth research organizations. Organized collective work has its limitations, and is bound to fail unless it is handled with consummate tact and understanding.

"A few weeks ago I read a delightful satirical article illustrating this point in an American popular scientific journal. The author described how Isaac Newton, having gained an inkling of the law of gravity when observing an apple fall in his college garden, went full of enthusiasm to 'His Majesty's Committee for Research and Development', since his many obligations as a member of numerous scientific committees were so heavy that he could not pursue his idea unless he were granted free time and assistance. What did the Committee then do ? It immediately turned Newton's idea into a grandiose project for the improvement of fruit growing in the United Kingdom. You see . . . once the basic law governing the fall of an apple were known, it would be possible to prevent fruit dropping prematurely off the trees. Newton was put in charge of 'Sub-project Apples' and was permitted to spend 10 percent of his time on basic research.

"Do not believe, however, that such fantastic events occur only in fiction. Here is a little story from my own personal experience. I had been put in charge of a research project in a certain country. At the end of the first year it was found that we had not completed the task scheduled for that year, although we had obtained other—in my opinion—much more interesting results. Nevertheless the responsible official withdrew his funds, because the contract had not been fulfilled. I told him that according to his theory Christopher Columbus had also failed. He had contracted to find a new sea route to India. Instead he discovered the continent 'where you and I are having our discussion on the philosophy of research'."

A tell-tale smile played about the corners of Professor Kármán's mouth: "Do you imagine he really understood a word ?"

In other words you see no possibility of organized cooperation ?

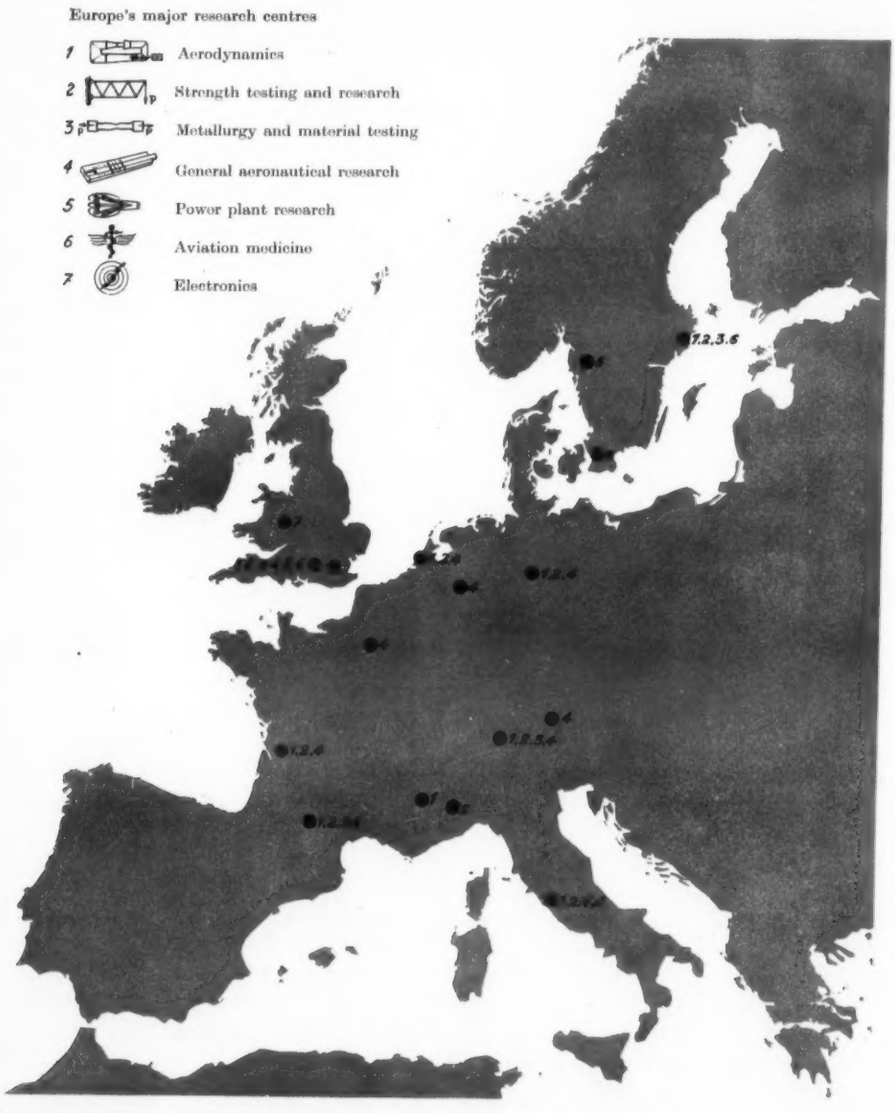
"No, on the contrary. Please do not misunderstand me. I am only warning against bureaucratic excesses. I believe that pioneer work can be promoted less by organizing, contracting and directing research than by creating the necessary climate and conditions in which it can thrive. In particular it means advising the men interested in research on the practical implications of the problems.

"Even the greatest genius, if obliged to work in isolation, would today come up against two serious obstacles, which make it almost impossible for him to reach his set research goals. Firstly, the equipment for experimental research is getting daily more elaborate and more costly. Secondly, so much work is being done throughout the world that a scientist without contact with other countries would waste a great deal of time on research that had already been done by his colleagues elsewhere.

"Where the NATO countries are concerned, it seems to me that the problem is not so much

AGARD (Advisory Group for Aeronautical Research and Development) has its offices at the Palais de Chaillot, Paris.

to create a vast super-organization as to try and arrive at a number of relatively small groups to deal with specialized tasks, in the cause of common defence. Because of conditions during the war and the post-war years many countries got a late start in modern aviation developments and manufacturing methods. Some have since made excellent progress, while others have been less fortunate. Both categories could benefit tremendously from contact between such research groups. By working in close collaboration they could provide the scientific and technical requirements for a new start. Most countries lack the time, money and scientific personnel even to sift through the mountains of scientific reports, even in the fields in which unrestricted exchange of information is possible."



What practical solution do you therefore envisage?

"The lack of testing facilities is one of the greatest impediments to the successful participation of certain NATO countries in the common production programme. Testing and research facilities cannot be dealt with separately because the actual equipment required is much the same for both. Without common research and development centres NATO's production programme can never be put into practice. I therefore consider that a kind of clearing house is desirable, to advise research men in one country on the facilities existing in other allied countries. However, the joint use of existing facilities is not enough. What seems to me to be just as important is the joint planning of new facilities for common use, so that each individual country can concentrate on the special branch of research for which it is best suited, providing equipment that is first class in quality and size, instead of duplicating equipment already existing in another country.

"I should also like to stress that many problems of fundamental research can be solved without complicated installations. If the scientists of the smaller countries are kept in touch with developments and with their colleagues in the larger industrial countries, they could make some very useful contributions at relatively modest cost. The law of probability shows that creative geniuses may be born in any country. The important thing is to give them the chance they deserve."

Thank you very much, Professor. May we ask one more question? Has any practical effort yet been made in this direction?

"What I have outlined to you here is, by and large, among the goals of the recently created Advisory Group for Aeronautical Research and Development, under NATO. AGARD, whose members include eminent representatives of aeronautical research from eleven countries, will advise NATO's Standing Group on all technical questions."

Professor von Kármán looked at his watch . . . "Nowadays airliners take off on the dot . . . Another success for aeronautical research."

Fortieth Anniversary of the Deutsche Versuchsanstalt für Luftfahrt

BY PROFESSOR FRIEDRICH SEEWALD, TECHNICAL UNIVERSITY, AACHEN

There is good reason to believe that Germany will shortly be permitted to engage in air transport and even in aeronautical research again.

One of the people who is working most actively for the return of the old Deutsche Versuchsanstalt für Luftfahrt (German Aeronautical Research Institute) is Professor Friedrich Seewald. Born in 1895, Seewald was a pilot during World War I. On completing his studies and a period of practical work as an engineer, he became scientific assistant to Dr. von Kármán, at that time Professor and head of the Aerodynamic Institute of Aachen Technical University. In 1925 he went to the DVL, where he worked on propeller, strength and aerodynamic problems. Ten years later we find Seewald as head of the DVL. Because of differences with the civilian and military authorities he was forced to retire from this position in 1941.

Today Dr. Seewald is professor and head of the Aerodynamic Institute of Aachen Technical University.

On the occasion of the 40th anniversary of the foundation of the DVL we have asked him to write a brief description of the old DVL and of the plans for reviving it.

EDITORS

When early in the present century the Wright brothers succeeded in making the first flight in a powered aircraft and in Germany Count Zeppelin carried out his first airship flights, one of mankind's oldest dreams came true. Men went to work throughout the world with daring and inventive genius and achieved astounding results. However, it was soon found that there was a long way to go before an aircraft could be produced to meet the demands of practical air transport. It became clearer and clearer that the ingenuity and devotion of the pioneers would have to be supported by systematic scientific work. For this purpose research institutes were set up in a number of countries. France, for example, founded the "Institut Aéronautique," and Britain a similar organization at Teddington.

In Germany Count Zeppelin took the initiative in founding the Deutsche Versuchsanstalt für Luftfahrt (DVL). He had early recognized that extensive and costly experimental equipment would be required for the continued development of aviation. He proposed that this equipment should be operated, for the advantage of all concerned, by an association grouping the whole of the aviation industry. This plan did not obtain general approval until several years later, and it not until April 1912—40 years ago—that the DVL was founded as a registered association. Interested industrial concerns and Government authorities became members. In structure and *modus operandi* the DVL resembled the non-profit organizations now working with such good results in the United States. The DVL retained its character of a private undertaking right up to the cessation of its activities in 1945, although a great many attempts were made, particularly after 1933, to nationalize the Institute or turn it into a Government or military establishment.

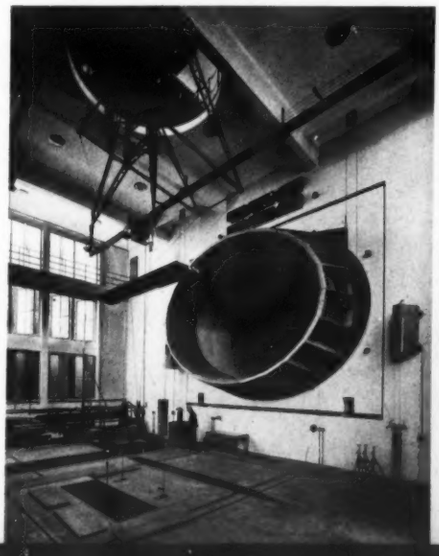
Overall view of DVL's installation early in 1932.

The DVL's first big task was to build up a testing service for aviation. As the scientific bases for the determination of flight safety and airworthiness were at that time still far from complete, a great deal of scientific pioneer work was required. The large number of scientific papers from those early days (on stability, spinning, propellers, strength problems, etc.) show that the principles had already been clearly recognized, although naturally more efficient methods have since been found of solving these problems.

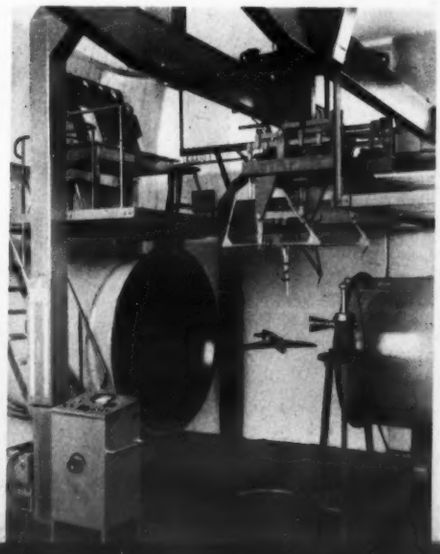
Some very painstaking and valuable experiments were also made in flight. For example the stresses occurring on the aircraft under different flight conditions were still very imperfectly known about the time of World War I. To throw light on these questions the DVL measured the forces on the bracing wires of biplanes in flight and thus obtained a reliable criterion for the magnitude of the stresses in the various stress cases.

The first period of the DVL's activity lasted only six years. In 1918, after World War I, the Institute was largely dismantled and work ceased except for minor testing assignments. It was not until 1924 that scientific work could be resumed, though at first on a very limited scale. Gradually, however, enthusiastic young scientists joined the DVL, and as time went by testing and research activity increased in scope. The experimental equipment available was extremely modest. Fig. 1 shows a general view of the Institute in 1930, with the few small laboratories and hangars for light aircraft. There was no large experimental equipment. Up to 1932 the DVL had neither a wind tunnel nor any up-to-date equipment for engine experiments. Its financial situation at that time simply did not permit the acquisition of such

Working section and funnel of DVL's large wind tunnel.



Small wind tunnel with six-component balance.



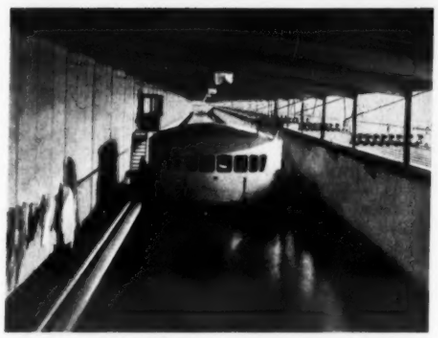
installations. Work therefore had to be restricted to what could be done with the limited means available. Nevertheless, a large number of scientific papers was produced between 1925 and 1932 which won the DVL the esteem and good will of the whole technical world.

A great many practical results were also achieved during this period. The first German variable pitch propeller was developed, for example. This was made by the Vereinigte Deutsche Metallwerke, Frankfurt, and was the most widely used up to 1945.

The period after 1933 saw the inspection side of DVL's work taken away and given to a military inspection centre. On the other hand, with the general development of aviation in Germany the DVL's financial situation also improved, and it was able to acquire similar installations to those which corresponding institutes in other countries had long possessed. In addition to a wind tunnel with a flow section of 16×23 ft., a high-speed tunnel of 9 ft. diameter was built, which reached approximately sonic speeds. An engine experimental section was constructed, including a test bench which enabled engines to be tested under very high altitude conditions. Installations for the various specialized subjects, such as materials testing, oscillation problems, theoretical mechanics, hydrodynamics of seaplanes, were modernized or provided from scratch.—As security regulations forbade the photographing of these installations, there are only very few pictures available. Such as there are shown here, to give an impression of the Institute as it was between 1935 and 1945.

With the aid of these new installations scientific work became much more intensive.

It is impossible to give even an approximate account, in the space available, of the multitude of papers prepared on the most varied subjects during this period. A great many of them were never published, for security reasons. Nevertheless there are many reports in technical



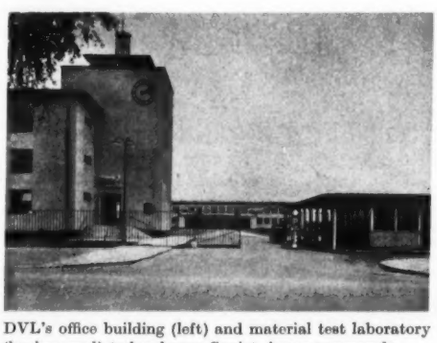
Towing basin for hydrodynamic model experiments.

journals, the DVL's annuals and, after 1938 when the German Air Ministry forbade the publication even of the annuals, in other yearbooks on aeronautical research. All these give a general picture of DVL's activities. They included investigations into friction drag on airfoils at high Reynolds numbers, laminar flow airfoils, the qualities of airfoils in the neighbourhood of sonic speed. Numberless investigations into questions of stability and the improvement of flying qualities helped to put German aircraft design on a gratifyingly high level. Much was also done in the field of strength and aircraft design. Heat-resistant steels and copperless aluminium alloys were developed. In the realm of gas turbine development, flight tests were made as early as 1937 with exhaust gas turbines with air-cooled turbine disc and blades, in which gas temperatures of about 1000° C were used. A whole long series of assignments, which were all well under way when World War II broke out, could thus be enumerated.

During the war working conditions at DVL got worse and worse. Mobilization greatly reduced the personnel strength, intervention by civilian and military authorities made long-term scientific work extremely difficult. Nevertheless the published papers from the war years show that the DVL remained true to its scientific task and achieved results that, far beyond their immediate purpose, have permanently enriched scientific knowledge.

The Institute[1] remained completely unharmed on the arrival of the Russian troops in April 1945. The majority of the staff had also stayed in Berlin. All the research installations were dismantled and taken to Russia. Today the leading members of DVL are scattered throughout the world, and many of them are obliged to earn their living in quite different technical fields.

Fortunately the political developments of recent years seem to open up the possibility of an early resumption of aeronautical research in Germany. A number of research experts who have remained in Germany are working for the resuscitation of a German aeronautical research institute. All concerned realize, however, that Western Germany, in spite of her generally high industrial level, is too small to meet all the requirements of present-day aeronautical development. The multitudinous problems of modern aeronautical research are so complex, and require the collaboration of so many first-class scientists and the provision of such costly equipment and installations, that a country the size of Germany cannot hope to cope successfully with all fields. Therefore all concerned hope that in time there will be closer



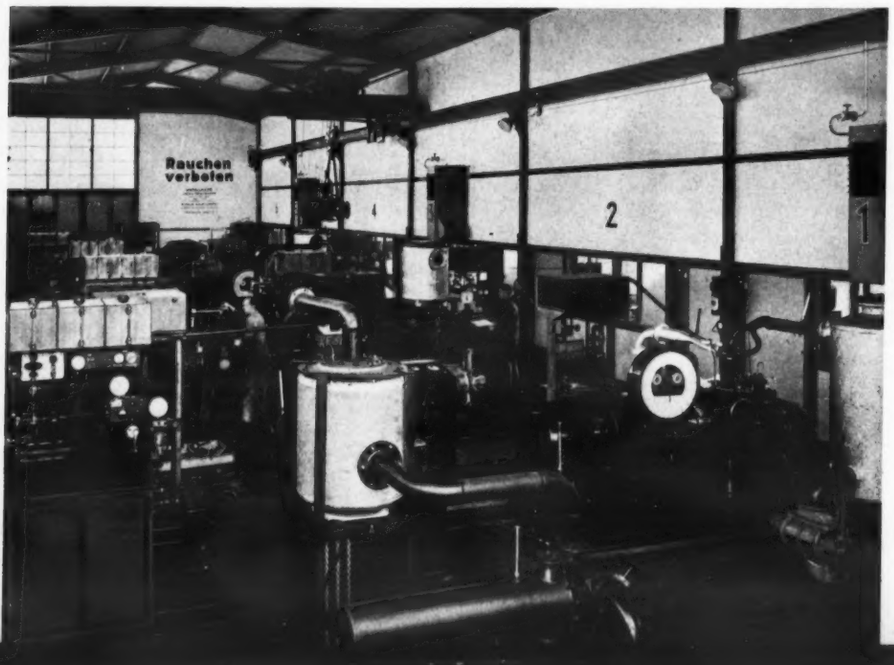
DVL's office building (left) and material test laboratory (background) today house Soviet Army commands.

cooperation between the countries of Europe, enabling the European community to obtain results beyond the reach of any individual country.

If the DVL is permitted to resume its work, its first and most urgent task will be to train scientific personnel for the various branches of research, so that they will be able to work for the progress of aviation.

Finally, may we express the hope that the DVL will succeed in making its contribution to the aeronautical research of our times and will enjoy the same friendly relations with colleagues in other lands as in earlier days.

Single-cylinder test benches.



[1] The Deutsche Versuchsanstalt für Luftfahrt was at Berlin-Adlershof.

Turin : The Fiat concern's Lingotto Aircraft Engine Division.

Naples : Industrie Meccaniche ed Aeronautiche Meridionali (and Mount Vesuvius).

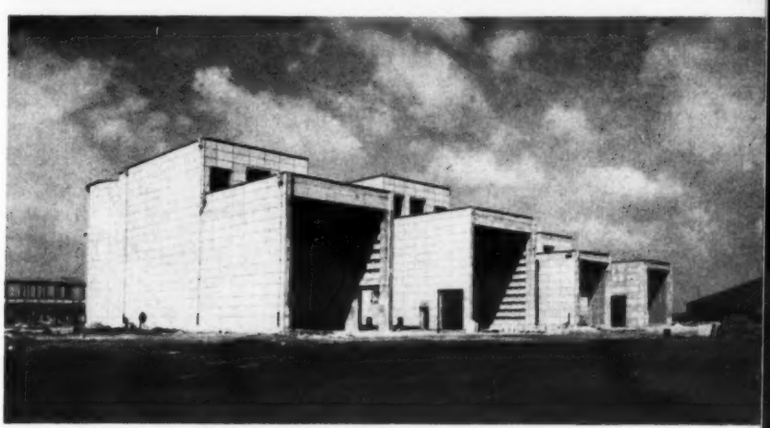
The European Pool of Aircraft Manufacturers

BY GEORGES HÉREIL

PRESIDENT OF THE INTERNATIONAL ASSOCIATION OF AIRCRAFT CONSTRUCTORS

PRESIDENT OF THE ASSOCIATION OF THE FRENCH AIRCRAFT INDUSTRY

CHAIRMAN AND MANAGING DIRECTOR OF SNCA DU SUD-EST



Paris : Some of SNECMA's new engine test beds.

Europe is in a state of flux. The aircraft industry is destined to become one of its most vital elements, for two reasons: firstly from necessity, and secondly thanks to the sense of responsibility which guides the manufacturers of aircraft.

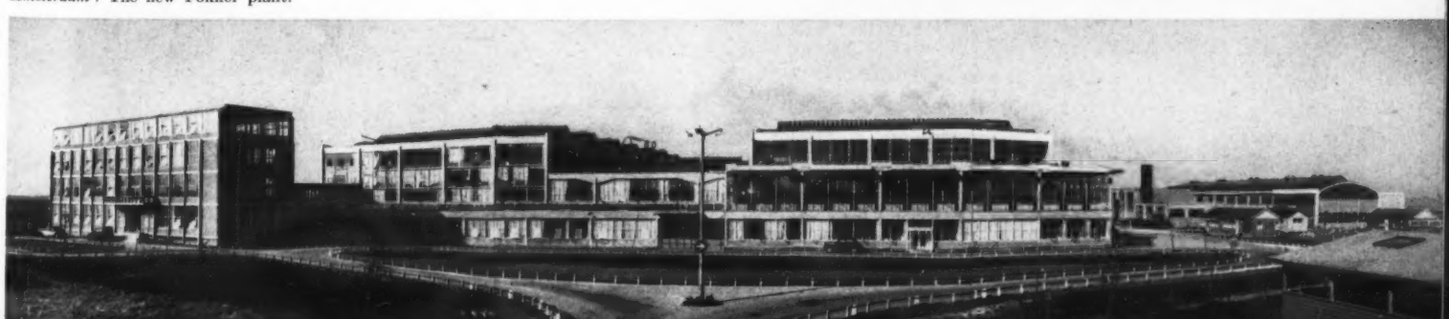
The necessity behind the pool of European aircraft manufacturers can be expressed in simple terms: technical development demands bigger and bigger qualified staffs, more and more engineers, more and more technicians. Although the state of apathy from which the various aeronautical industries of Continental Europe are at present suffering has kept them from experiencing difficulties in recruiting their labour force, one has only to read the American and British magazines to realize the troubles the different aircraft firms are having in finding the engineers they now need to supplement their normal staffs.

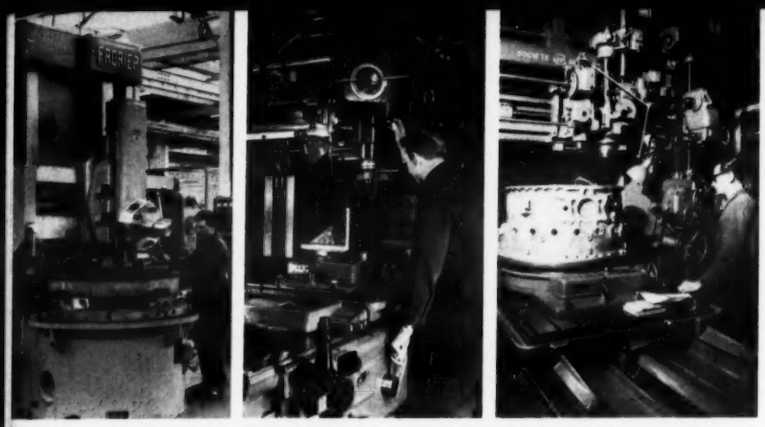
We must therefore prepare for a pooling of Europe's brains, which, in spite of their differences of background, are perfectly capable of agreeing among themselves and of working together without difficulty, using the metric system which constitutes a bond of union between them all.

Behind the technical complexity of modern flying equipment and its high performance lurks the sinister shadow of the budget deficits which ceaseless progress threatens to create; a pooling of intellectual effort would have to be accompanied by a pooling of financial efforts.

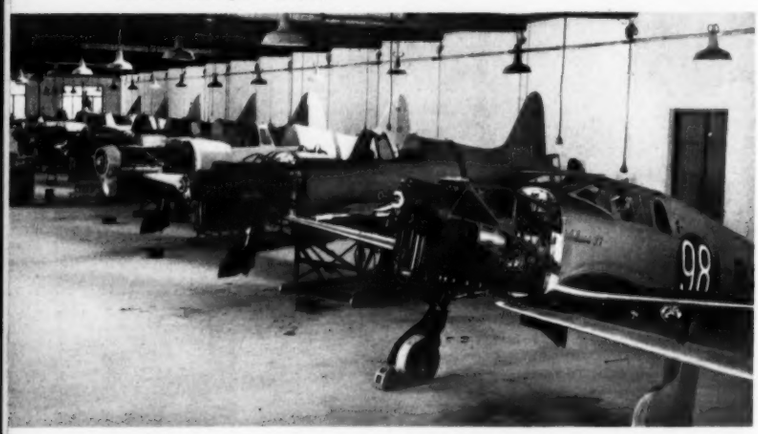
Toulouse : SNCA du Sud-Est's plant.

Amsterdam : The new Fokker plant.

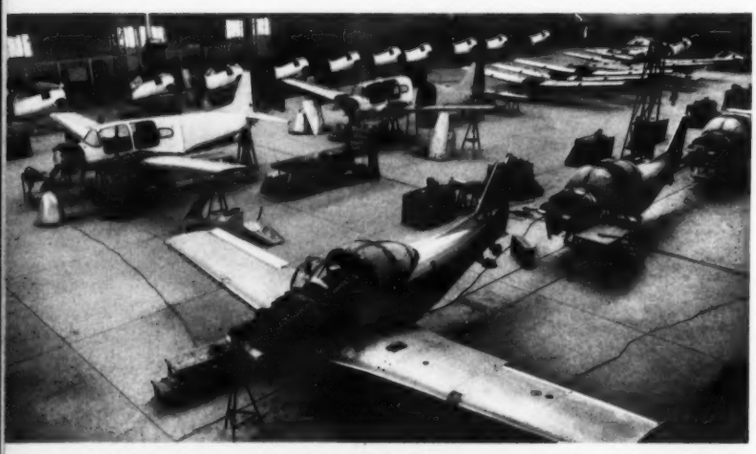




There is no lack of modern, specialized machine-tools in Europe : Vertical lathe at the Fiat plant building the D.H. "Ghost" engine *(left)* ; drilling and boring machine at the Fokker plant, used for jig manufacture *(centre)* ; drilling and boring machine at the SNECMA plant *(right)*.



Passignano (Lake Trasimeno) : Ambrosini S-7 trainers in quantity production.



Varese : Final assembly of the Macchi M 416 trainer (Fokker S.11 under licence).

Turin : Production line of the Fiat G.59 two-seater fighter-trainer.

NATO Air Build-Up

Finally, complicated and costly research and experiments can only be justified if they are followed by substantial quantity production. The funds devoted to research can only be written off by the prototypes which turn out to be successful. Failures are part of all human endeavour ; not every oil well prospected, for example, is successful or productive. The quantity of aircraft produced must therefore be large enough to cover not only the costs of their own prototypes but also of the prototypes which do not get into quantity production.

But here aircraft producers are motivated by more than necessity. They also have a high sense of their responsibilities towards the peace of Europe.

The European community is difficult to construct, but it is indispensable to the survival of the nations comprising it. An effective alliance between them must lead to a pooling of their efforts. Among all the various types of industry, the aviation industry would appear to lend itself best to unification.

Lindbergh had suggested in 1938 that a good method of preventing the war which threatened the old Continent, and behind it the whole world, might be to give each of the future belligerents the same flying equipment. Being thus of equal strength, the opposing countries would have been able to see the futility of going to war.

A European pool would lead to integrated production, rendering each country dependent on and hence closely bound up with all the others. The prospect of eliminating the possibility of war between European countries is well worth any effort at unification.

What has been done up to the present ?

Following visits by Italian manufacturers to France and French manufacturers to Italy in November 1947 and June 1948, the French *Union Syndicale des Industries Aéronautiques* and the Italian *Associazione Imprese Aeronautiche* decided in May 1949 to form a co-ordinating committee between the French and Italian producers of aeronautical equipment.

In April 1950 the *International Association of Aircraft Constructors* was founded in Paris, on the initiative of Mr. Vos, Managing Director of Fokker, who became its first President. The Association counts manufacturers from Belgium, Spain, France, Italy, Norway and Holland among its members.

New contacts have been established thanks to this Association, and opportunities for cooperation have been born. Positive results have been achieved on certain points. These are known, and others will be—in the three major fields of research, design and production.

Europe has wind tunnels, test centres, laboratories. It would be natural to pool them. Certain secondary questions, such as secrecy between the various nations belonging to the pool, would have to be settled, so as both to overcome certain immediate obstacles and to prepare a more constructive future.

Leading Personalities of Europe's Aircraft Industry

P. J. C. Vos, Director-General of the Fokker works, first President of the International Association of Aircraft Constructors (AICMA).

G. Héreil, Chairman and Managing Director of SNCA du Sud-Est, President of AICMA and of the Association of the French Aircraft Industry (USIA).

General A. Bruno, President of the Association of Italian Aircraft Manufacturers (AIA).

G. Gabrielli, Technical Director of the Fiat company.

P. Gallo, Chairman of Alfa Romeo.

A. Piaggio, Chairman of Piaggio & Co., aircraft and engine manufacturers.

Amsterdam : Belgian Douglas C-47 "Dakota" military transports undergoing overhaul at the Fokker plant.

Amsterdam : Gloster "Meteor" twin-jet fighters in quantity production at the new workshops of the Fokker company.

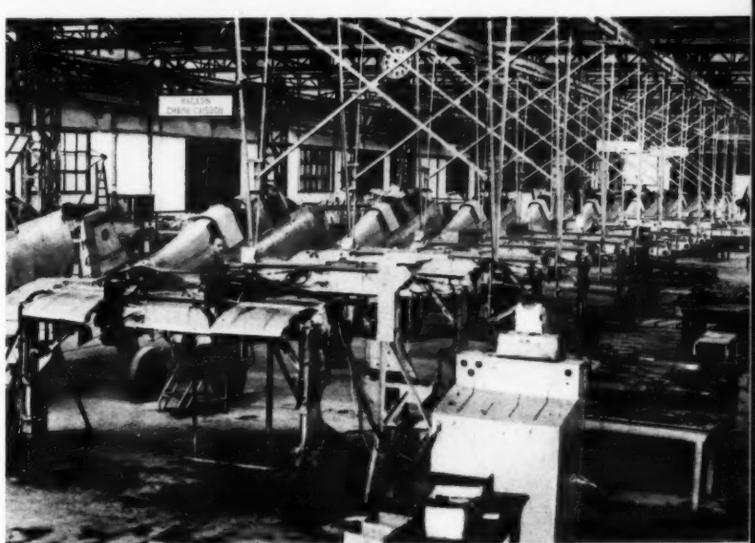
In the design field, several French firms recently banded together into two groups, in connection with a project for a medium-range civil airliner, to pool their design facilities if the project put forward by one of their members should be selected and ordered. This intelligent and effective integration should be extended to the European level, where it could also produce good results.

An aircraft produced under such a collective system would be a European product, of which each of the countries that had contributed financially or intellectually to its production could be equally proud.

On the production side, the engineering industry is highly developed in Europe. Plant already exists, the force of skilled labour can be rapidly increased, and I am convinced that here too there is a highly important potential.

Instead of building little parallel production lines, we shall have to have one single large one, each country specializing in the production of one major part of the aircraft. However, to make sure national susceptibilities were not injured, it would be possible to set up a general assembly centre in each country. Tooling for general assembly is the least costly, and general assembly is also the best schooling for the inspection and repair of aircraft.

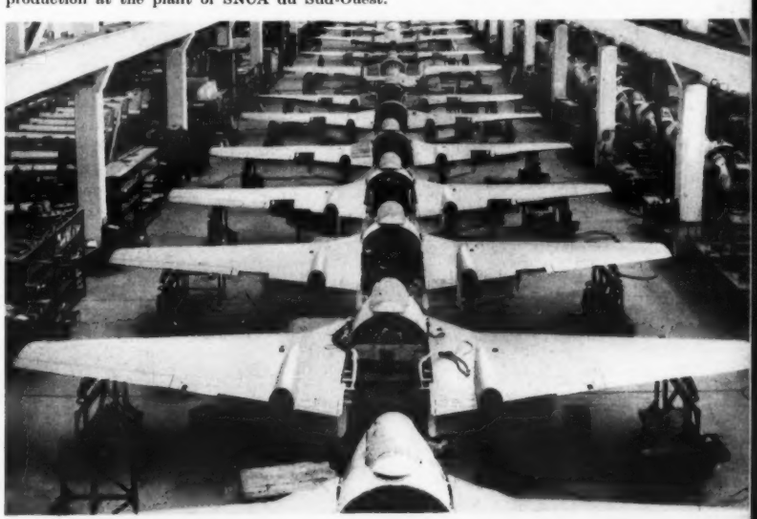
In 1936 France nationalized part of her aircraft industry. She now realizes that the next step is its internationalization on the European level. And the manufacturers who belong to the International Association of Aircraft Constructors know that the industry of each of the European countries must be European if it is to exist at all.



Ossun (Basses-Pyrénées) : Morane-Saulnier MS.472 advanced trainer on the assembly line.

Paris : Dassault MD 450 "Ouragan" rear-fuselage production line at a factory of SNCA du Sud-Ouest.

Marseilles : D.H. "Vampire Mk.5" and "Mk.53-Mistral" jet fighters in quantity production at the plant of SNCA du Sud-Ouest.



NATO Air Build-Up

Co-ordinating the European Equipment Industry

BY RENÉ LUCIEN, PARIS,

INGÉNIEUR DES ARTS ET MANUFACTURES, F.R.Ae.S., M.I.Ae.S., M.S.A.E.

Equipment maker unknown . . . once said J.C. Garrett, President of AiResearch, one of America's leading air accessories firms, drawing attention to the paradox that few in the technical world recognize the central importance of the equipment industry to aircraft research, development and production.

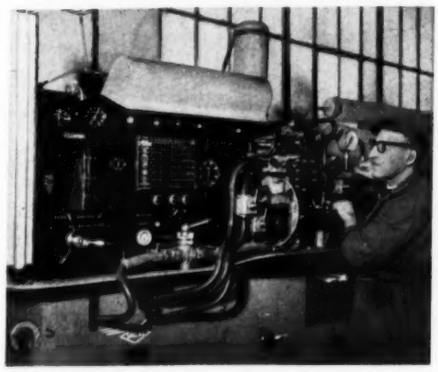
From the financial point of view the equipment of modern military aircraft makes up some 45 percent of the total cost. In the latest American all-weather fighters the electronic equipment alone accounts for this percentage.

Airframe and engine manufacturers are subject to the central control of their country's authorities, and long-term investment and production programmes are drawn up for them. But the equipment industry still gets its orders, so to speak, "second hand" and is thus subject to the laws of free enterprise on the one hand and to the unsettling influences of a fluctuating armament demand on the other.

Even the aircraft designer runs a certain risk when he submits his design to the contracting authority. He has no idea whether he can hope for a production order. For the manufacturer of equipment this risk becomes immeasurably greater. The designer can decide on given items of equipment for his new model, but he cannot place a quantity order until the engine or aircraft concerned is itself ordered in quantity. Not only this, but the designer can decide on quite different equipment during the production run—as often happens—and give part of the order to a competing firm.

Undercarriages or retraction cylinders specially designed for a particular aircraft type will, of course, not suddenly be ordered from elsewhere. But in the case of standardized equipment, such as pipes, parts for air-conditioning plant, etc., it is by no means uncommon for orders to be "switched" to some other supplier.

This would not be of any particular importance if the aviation market were not so small. As things are today there is no balancing effect of supply and demand. And there is in addition the constant uncertainty of the armament programme. All in all it is often difficult for the management of an accessories firm not to lose heart.



Testing fuel pumps for jet engines, on one of SNECMA's test benches.

In the airframe industry the government can control research and production separately. Public funds bear the brunt of research and development, so that manufacturers can work much more economically. The cost price of an aircraft varies only to a small extent with the number produced. Moreover, finished products can be exported at competitive prices.

The relatively small number of aircraft firms renders such a policy possible, and the tremendous sums involved lead the purchasing authority to restrict its dealings to a small number of efficient firms. When all the prototypes for a given programme have been examined, frequently only one of them is ordered.

In the equipment industry, on the other hand, the competition stimulated by the aircraft manufacturers leads constantly to better, lighter and cheaper products and finally to a constant increase in the number of accessories firms. For this reason alone the government is frequently no longer able to support research and development in the equipment industry.

The industry therefore can only live if it gets enough orders, so that money invested in research can be provided from current profit. In times of crisis research must cease, which may ultimately lead to the failure of the firm.

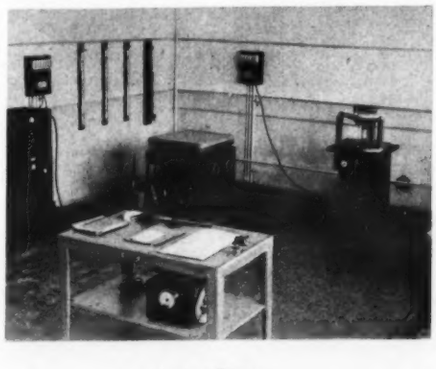
Finally, we should not forget that really large production series of aircraft—even in the United States—are nowadays rare, and that a monthly output of 30 or 40 aircraft is far too small to permit of mass production methods such as are used in the automobile industry.

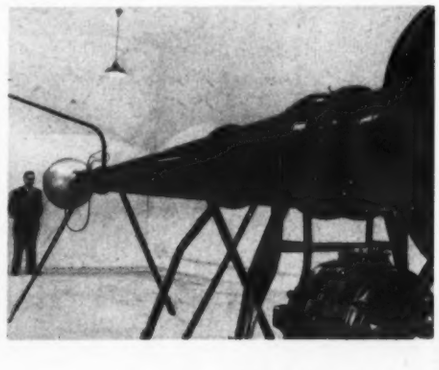
*

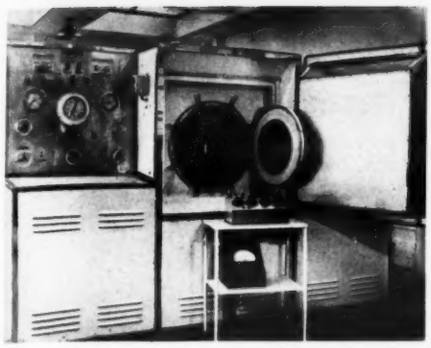
If we follow the latest developments in the European equipment industry, we find the waste of time and money almost staggering.

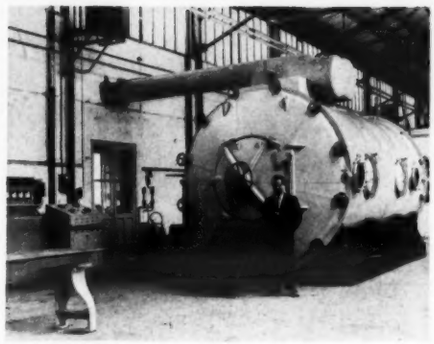
When de Havilland sold licence rights for the "Vampire" successively to Sweden, Switzerland, France and Italy, a completely new equipment industry—even working on English measures—grew up in each of these countries, to supply from 80 to 300 sets of equipment.

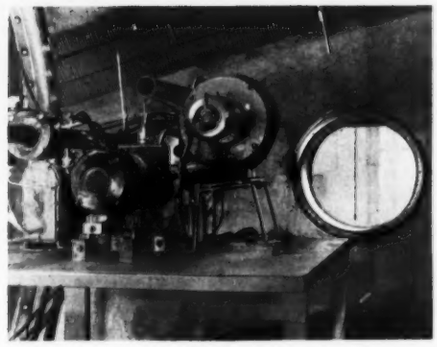
A well-equipped central laboratory has been set up by the association of the French equipment industry (SOPEMEA). Left: View of the vibrations test room, with two measuring benches. Right: 20-cm wind tunnel for flow velocities of up to 435 m.p.h.











SOPEMEA's small and large high altitude test chambers. The small chamber has a volume of 4.6 cu.ft. and can produce a temperature of down to —60° C at absolute pressures of down to .75 in. mercury. The large chamber has two independent sections, 35.3 and 17.65 cu.m. in volume, and has a measuring range down to —70° C, at 2 in. mercury. Right : checking a vacuum pump in the high altitude chamber.

Translation of the specifications into the language of the country, examination of the drawings, provision of new jigs and tools, construction of test benches—all this for a daily output of one fighter—consumed so much time and labour that there can be little hope of Europe's ever acquiring an efficient or economic air force in this way.

In addition, licence negotiations have hitherto been conducted only from the point of view of private economic interests. For example, a French licencee may not sell his products to other Atlantic Pact countries without special authorization. If such authorization is obtained, with much trouble, it can be withdrawn again at any time if orders at the home works fall off.

Such economic selfishness can never lead to the desired goal, the common defence of Europe. It is by no means sufficient to make pacts and set up armies. Equally important is a new licencing policy for armament equipment. Instead of granting licence rights, as hitherto, on a purely commercial basis, they should in future be distributed among the various countries under the best possible conditions for the community.

As regards *research,* it is economically quite impossible for every European country to carry out development work in all of the constantly expanding fields of modern engineering. Budget considerations make selection essential. Each country should decide in what field it can make a worthwhile contribution to research, with due regard to the special qualifications of the personnel concerned and to the means available.

Such a division of labour should lead to a common European control of investment in and the equipment of laboratories and factories, such as is already the case in the aircraft and engine industry.

In other words, the equipment industry must be placed on the same level as the aircraft and engine industry in future European community planning. Any imitation of foreign methods with the sole object of creating a "national production" is harmful. To conserve the valuable nucleus of the European aviation industry, concentration of effort on a small number of objectives is essential.

*

A promising beginning has been made in France in the field of laboratory research. The steps so far taken do not yet go far enough, but they are evidence of an effort to find a reasonable solution. The new *professional organization, SOPEMEA,* has been given the task of centralizing all the experimental installations required by the armament industry. This should avoid duplication of equipment costs and ensure that equipment handed out by the central office can be made available to all accessories firms without distinction.

Under today's irrational system the maker of, for example, a generator must test it on his own test bench and then send it to the contracting authority *completely dismantled.* The latter then re-assembles the "model generator" and submits it to a further check on the official test bench. Result :

(1) As test conditions at the makers often do not correspond to those at the Government laboratories, there are not infrequent disputes.

(2) Test bench runs are costly as a rule. Test runs of a high-pressure hydraulic pump, for example, cost up to 1,500 French francs an hour, and endurance runs take several thousand hours.

It would therefore undoubtedly be useful to have permanent government inspection centres attached to SOPEMEA, as to all similar laboratories, and to give these authorities international recognition. When an accessory firm develops a new piece of equipment, it would only need to demonstrate it at the central laboratory and could receive —after, say, an endurance test run of a thousand hours—a certificate of airworthiness recognized in all countries. This simplified system would save millions.

Of very great importance finally would be a system of international standards. Or at the very least the technical inspection centres in the various countries should agree on common acceptance conditions.

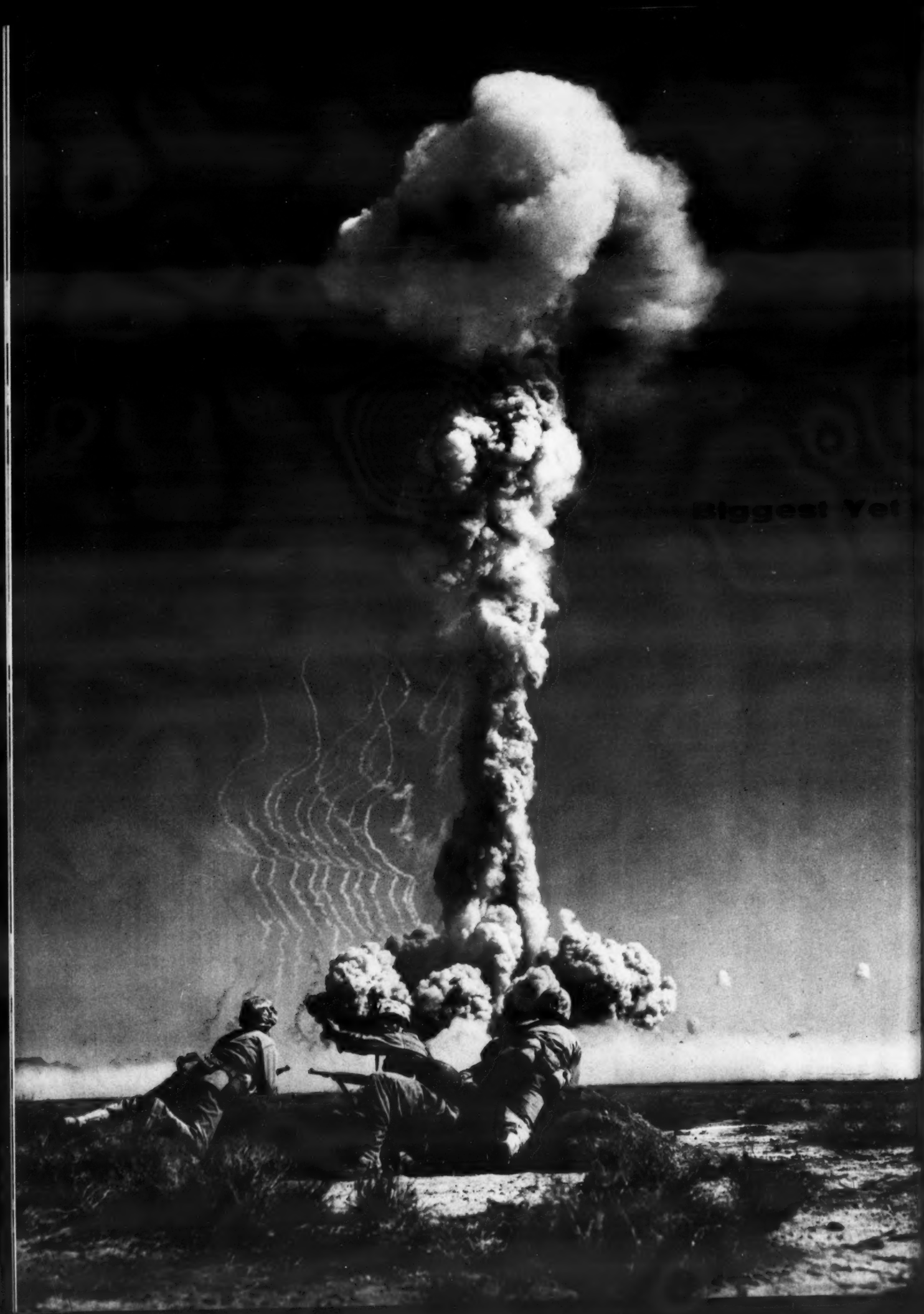
Is it possible to conceive of a more ridiculous situation than exists today, when a country accepting a licence can refuse well-tried equipment from the licencing firm until it has undergone a further long series of tests, under different conditions from those of the country of origin ?

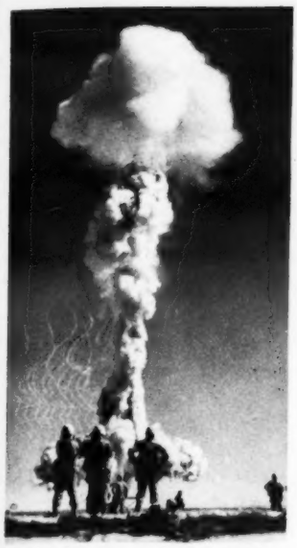
It is true that serious efforts have been made to unify the technical rules in force in the various countries. They are not yet sufficient, however, to avoid overlapping in research.

Greater confidence should also be placed in the manufacturers ! If a reputable manufacturer guarantees that his equipment has reached this or that performance on the test bench, it should really not be necessary to have it tested again by the authorities. Should a manufacturer then infringe the most elementary code of honesty by making false statements, he should be removed immediately by common consent from the list of European equipment firms.

*

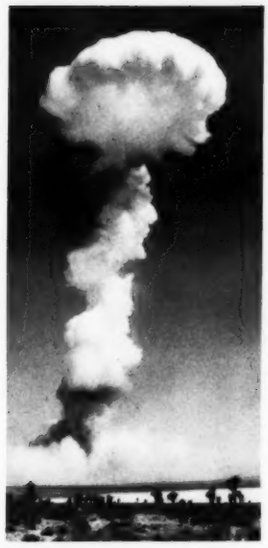
In conclusion it will be found that the "Europeanization" of the equipment industry is merely a question of general human cooperation, of moral integrity and good will. If all concerned cling tenaciously to their own exclusiveness, the equipment industry can no more develop than can the rest of European civilization. In spite of its past greatness, our Continent would, technically and politically speaking, stagnate.





The Marines emerge from their 5-foot slit trenches, about 3½ miles from the target.

Troops start towards the target area. A huge dust cloud begins to rise at the base of the mushroom.



The mushroom is fully formed—the dust cloud continues to rise. Yucca Basin takes its name from the vegetation in the foreground.

Officials of the Atomic Energy Commission watching the cloud produced by the bomb.

The biggest atomic bomb ever to be detonated in the USA, equivalent to 25,000 tons of TNT and rated as twice as powerful as those fired at Nagasaki and Hiroshima and "more powerful" than those tested at Bikini, was exploded at the Yucca Basin proving ground, Nevada, of the U.S. Atomic Energy Commission at precisely 6:29 p.m. EST on Tuesday, April 22nd, 1952.

It was dropped from 30,000 ft. by a Boeing B-50 "Superfortress" four-engined bomber accompanied by two others carrying test instruments. The bomb exploded at between 3,000 and 3,500 ft., 42 seconds after being released, and took 51 seconds after dropping to produce the characteristic mushroom cloud. The colour of the mushroom changed gradually from a roseate hue to yellow and finally white. The actual burst was within 200 feet of its designated target pinpoint.

Meteorological conditions were perfect for the trial—windless, clear and warm. The target was a 300-ft. tower, the position of which was delineated on the desert floor by large black and white concentric circles.

A significant feature of the test was that combat personnel—2,100 Marines, most of them housed in five-foot slit trenches 3½ miles from the target—took part (for the second time) in an atomic exercise shortly after the explosion. Their participation included a "special mission" by 120 paratroopers who bailed out somewhere behind the target fifteen minutes after the explosion; others were driven into the area an hour after the burst.

The use of a relatively large number of troops so close to the explosion shows that during its series of air drops at the Nevada testing site the USAF has gained complete confidence in *the accuracy of its bombing technique*. Bad targeting of the bomb or deviation from the predetermined burst altitude easily could have resulted in numerous casualties. As it was, no personnel injuries were reported beyond minor abrasions from sand flung into the mouths of gaping troops who leaped from their trenches and stood, with their mouths open, staring at the spectacle as the shock wave ripped across the desert towards them.

The April 22nd test aroused speculation as to whether the bomb was triggered to fire automatically; whether it was fired by radio impulse from the B-50 that had carried it; or whether it was set off by radio command from the elaborately instrumented ground control blockhouse at the proving ground. Government spokesmen refused to disclose the firing technique.

Convincing proof of several things was provided by the test:

(1) Troops anticipating an atomic burst in an open combat area can survive, even though they may be within four miles of the blast, if they use moderate protective cover, such as slit trenches or adequate terrain depressions shielding them from direct exposure to heat and primary radiation.

(2) Immediate advances of troops can be made into the blast area, with due regard for structures and equipment which may retain dangerous amounts of secondary radiation.

(3) This means that an invasion of the area can presumably be made, by surface and airborne troops, before a stunned enemy (i.e., personnel surviving by virtue of slit-trench or other protection) can gather his wits and offer effective resistance.

(4) The test again pointed to the combat effectiveness of air bursts several thousand feet above the ground, especially in an area of loose topsoil. The blast raised a massive cloud of dust which obscured the target area for a considerable period and would have added seriously to the confusion of any enemy survivors within the critical area of the attack zone.

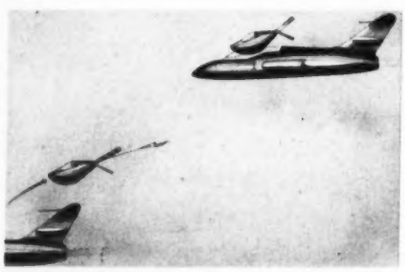
Brigadier-General Harry P. Storke, U.S. Army, inspects the damage to a test vehicle after the blast.

An enemy might suffer from added confusion from the dust cloud thrown up by the explosion.

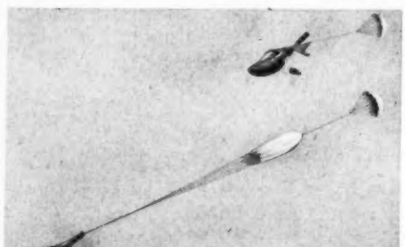
About a minute after the burst: the shock-wave has passed the Marines in their slit trenches and the typical mushroom configuration has practically formed.

The U.S. Navy's Contribution

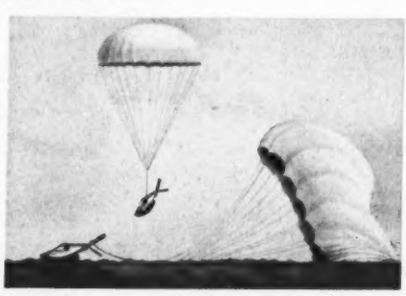
For several years the U.S. Navy Bureau of Aeronautics has been working on a jettisonable cabin for stratospheric aircraft, to protect pilots baling out at high altitudes from oxygen lack, low atmospheric pressure (caisson sickness) and extreme cold. The cabin floats, thus eliminating need for Mae West or rubber dinghy, and carries emergency rations, life-saving and radio equipment. How would it be, it may be asked, if all the expensive navigation instruments, and even sights and radar equipment, were housed in this capsule ? Then they would no longer be lost with the aircraft, and at any rate some 50% of the fighter's total value could be saved.



As pod is ejected from airplane its fins extend. Drogue chute gun fires out drogue chute in deployment bag.



Drogue chute tension operates delay mechanism and opens main chute door allowing deployment bag to be pulled out.
Main chute extended.



Main chute open for descent.
After pod strikes water pilot releases chute and lowers battery into water, for stabilization, in one operation.

Short-Life Aircraft or ...

The theme of our last issue—*Can air defence be bought more cheaply ?*—has given rise to lively discussion among engineers and military experts. The idea of the expendable or short-life aircraft, launched during the last war in connection with the air defence of Germany, has received particular attention. At that time Germany, with her war economy over-strained, had to choose between immediate surrender and the production of large quantities of cheap arms capable of defending her against the Allied bomber formations. She chose the latter—and failed. Today rearmament is faced by similar problems, owing to the fact that the price of aircraft has increased tenfold. The following are some of the arguments for and against this solution :

For	Against
The short-life aircraft is much simpler and cheaper than the conventional aircraft. It can be produced in large quantities from non-strategic materials, wood or plastics.	A comparison of costs must be based on the number of missions performed. A conventional fighter can make 20 to 50 in wartime, a short-life aircraft only 2 or 3. Why ? In the event of technical failure or bad weather on the ground the pilot of the short-life aircraft will bale out and abandon his machine, whereas he would do his utmost to land a conventional one.
*	*
The engines of a short-life aircraft need not be handled so carefully. They can therefore obtain higher peak performances, particularly during climb.	True, but only medium power engines are suitable for short-life aircraft. This limits take-off weight to a few tons ; what about the fire power and equipment of such aircraft ?
*	*
Equipment could be radically simplified and need comprise only the strictly necessary (e.g., a pressure suit, oxygen equipment and a R/T receiver), which the pilot could take with him when baling out.	This is true only of day fighter operations at low and medium altitude. Night and all-weather fighters need costly radar and gun sights. In the stratospheric fighter a pressure cabin is indispensable and cannot be replaced by a heated pressure suit. Finally, blind flying instruments, sights and ejector seats are lost with the aircraft.
*	*
Ground organization is less complicated. The short-life aircraft needs no maintenance, hence simplifies logistics.	Equipment and crews are required to salvage the machine and return it to its point of departure.
*	*
Departures and landing bases are less vulnerable.	An advantage to be borne in mind.
*	*
More rapid training of flight personnel. Reduction in specialized maintenance personnel.	This was proved by the Germans with their Me 162 and He 163. But how is training to be done in peace time without taking excessive risks ?
*	*
Thanks to the simplicity of the short-life aircraft, large stocks can be made, an important point in modern air warfare.	Yes, but does not the equipment stocked run the risk of becoming rapidly obsolescent ?

...High Performance Fighters

The U.S. Air Force, most powerful element in the NATO air forces, continues to swear by *high performance fighters*. This is clearly shown by the latest and most up-to-date creation of the Lockheed Aircraft Corporation, the *F-94C "Starfire,"* designed for the defence of American industrial centres.

In the last issue ("Guardians of New York") we reported on the A and B versions of this aircraft, both very fast, both with high rate of climb... but still armed with .50-in. machine guns. At last, however, the experts' repeated and sometimes biting criticism of the utility of small-calibre weapons against modern bombers ("slingshots for aircraft") appears to have made itself heard. The C series is no longer fitted with firearms but with 2.75-in. rockets. Up to 24 of these projectiles, which are lethal to even the "toughest" bomber, can be fired singly or in a salvos.

The F-94C is almost entirely automatic—in spite of its two-man crew. Its full electronic equipment weighs over 1200 lbs. All the pilot and radar operator have to do is to get the aircraft up to operating height in a hurry and into the area indicated by ground radar. When they sight their "victim," either with their own eyes or on the radar screen, they get into position... *and switch over to full automatic control.*

Result: the hitherto highly biddable aircraft turns into a self-willed robot. Once it "scents" the target by means of electro-magnetic waves, it follows close on its heels and refuses to be thrown off by any tricks. It is useless for the quarry to try and hide in the clouds, or to evade its pursuer by diving or making sharp turns. By-passing man and his human errors, the radar sight in the fuselage nose transmits all course corrections immediately and reliably to the fighter's automatic pilot. Even the rockets are released automatically, at the correct range. Shortly beforehand the four doors over the ring of rockets are automatically swung inwards. The pilot may, if he wishes, *decide in advance* whether one, three, six or all 24 rockets shall thunder forth automatically, or whether he will try his own hand as marksman. Otherwise he could sit and read while the enemy is being shot down... at any rate in theory.

The F-94C's *automatic pilot* (Westinghouse) is described as the "most sensitive instrument of its type ever developed." Despite its three gyroscopes it is no bigger than a portable radio. Unless he turns over control to the radar sensing equipment, the human pilot is able to maintain overriding control himself; by turning the instrument's control knob to left or right he can turn the aircraft, and by moving it forward or backward he can gain or lose height. For instrument landings a Sperry Zero Reader is fitted.

From the structural viewpoint it looks almost as if Lockheed might be staking everything in the battle for the supersonic aircraft on the straight, thin wing. In view of the general enthusiasm for the delta wing this is somewhat surprising. However, Lockheed has for years had every opportunity of trying out both delta wing and sharply-swept wings on high-speed aircraft. Yet the F-94C, its latest model, which is apparently planned for a long production run, again has a straight wing. And everyone, from top engineers down to test pilots, is full of enthusiasm for the design, without a hint of regret. Normally the F-94C will fly at a little below Mach 1, but with afterburner operating or in diving flight it will undoubtedly reach supersonic speeds.

The extremely thin wing has a single-spar foundation with integrally stiffened skin and ribs machined out of curved metal blocks. Other innovations are: swept horizontal tailplane: replacement of flush ducting of air intakes by ducts separated by several inches from the fuselage skin (somewhat similar to the oil cooler intake in the F-51 "Mustang"); a ribbon parachute to reduce landing run. Gross weight has increased to over 20,000 lbs.; slight alterations have been made in dimensions (span 37 ft. 6 ins.; length 41 ft. 5 ins.); the engine is the new Pratt & Whitney J-48.P-5 (Rolls-Royce "Tay" licence) of 6,250 lbs. static thrust; afterburner and take-off rockets provide additional thrust on take-off or during flight.

The new fighter was first demonstrated to the press at the Palmdale Jet Center in the Mojave Desert recently. It was flown by *"Tony" LeVier,* Lockheed's chief engineering test pilot. He had it up to 15,000 ft. in a matter of seconds, then went into a dive and shot over the airfield with afterburner roaring. Quite an impressive performance!

*

The above opens a discussion of the pros and cons of consumable or short-life aircraft as against, for example, the United States' latest all-weather fighter. Use of the short-life fighter for the defence of pinpoint targets should not be rejected *a priori*. It may well be that, as so often before, economic considerations will win the day over tactical advantages. But must there be a choice between the two alternatives? Would not high-performance fighters *plus* short-life fighters be the ideal solution? The question merits consideration.

Straight, extremely thin wings are also featured in the latest, fully automatic version (F-94C) of the Lockheed "Starfire" all-weather two-seater fighter. Pratt & Whitney J-48.P-5 engine, with afterburner. Ribbon parachute in rear fuselage.

The 24 rocket projectiles (2.75-in. calibre) in the F-94C are grouped round the radar nose, in the best position for firing. A single direct hit will knock any bomber out of the sky. Note air intake ducts.

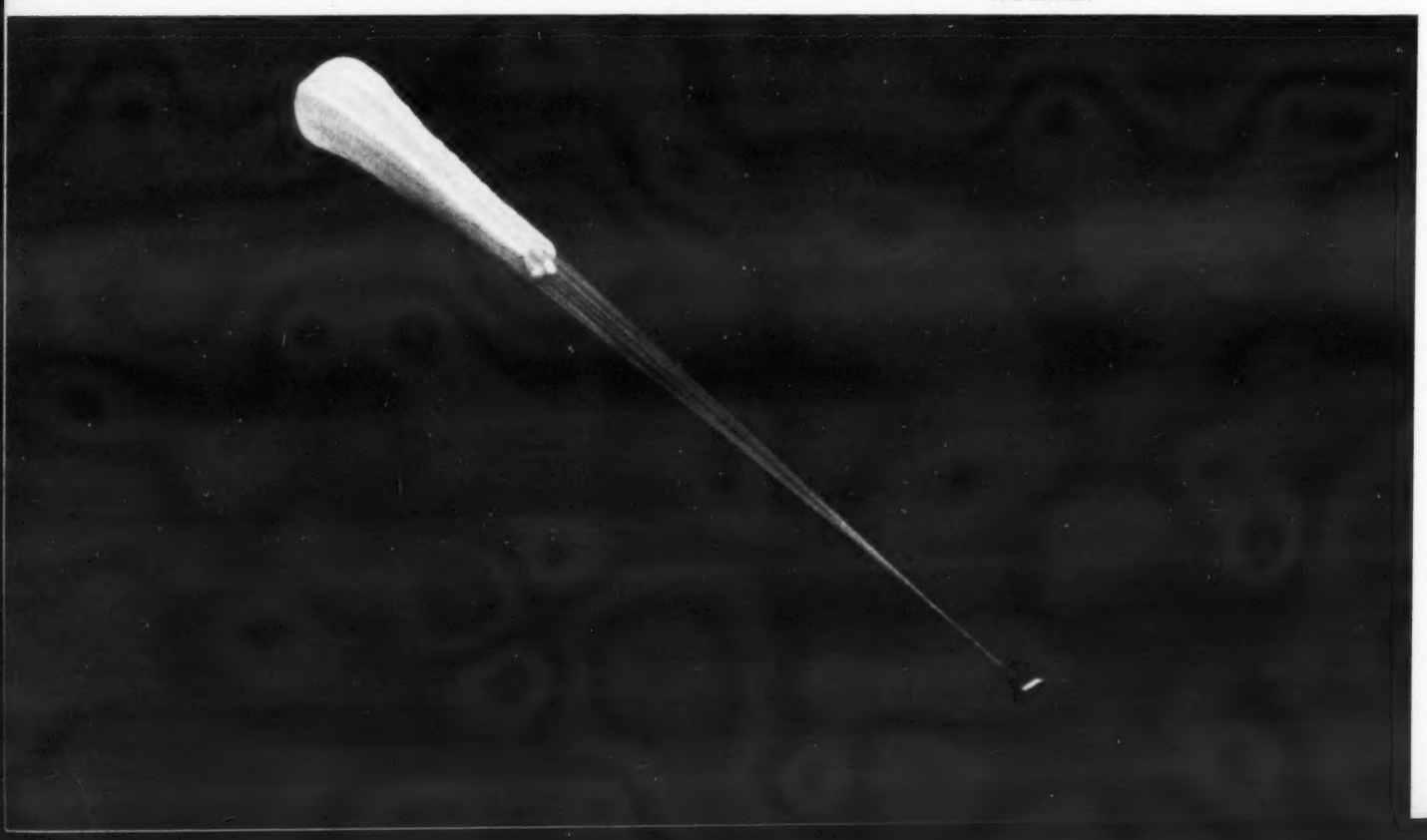
This is the start of the test drop of the 12,000-lb. (load with the 200-ft. diameter 'chute. From within the cargo compartment of the Fairchild C-119 "Packet" (or "Flying Boxcar") a four-pound shot-filled bag has been released. In turn, it has pulled free a three-foot pilot 'chute which, in turn, has released a 24-foot extractor 'chute. The latter is seen here fully opened and tugging at the six-ton load which is still inside the aircraft, attached to the big parachute packed in a canvas bag.

The extractor 'chute has pulled the large 'chute and the load clear of the aircraft and then jerked off the canvas container bag of the big 'chute. The giant is now trailing free but is reefed against a sudden "explosive opening" which would tear it to shreds. In the distance, behind the big 'chute, can be seen the now detached extractor 'chute, container bag and tiny three-foot pilot 'chute. The hazy small cloud in the cloudless Californian sky between the two parachutes is talc used in packing the big 'chute.

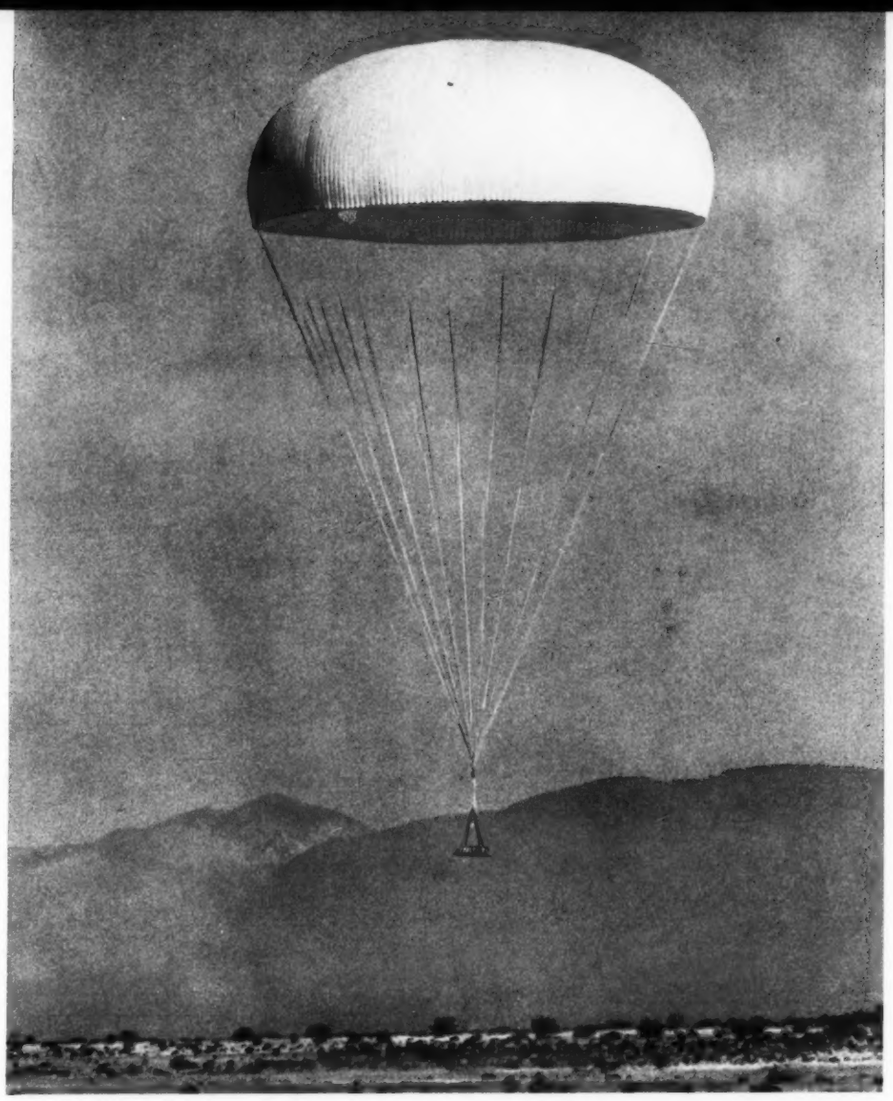
Six-Ton Parachutes

A new series of parachute tests was started at the *U.S Navy-Air Force Parachute Test Center* at El Centro, California, in the first days of June. So far, very heavy military loads have usually been dropped by attaching them to several (up to six) of the largest parachutes then available, namely, 'chutes measuring 100 feet in diameter.

Still reefed, the big parachute is beginning to open. An automatic timer will release the reefing after a lapse of four seconds.



Unreefed and fully opened, the "big one" here is caught in the last moments of its 24-ft./sec. descent to the sand-and-sagebrush floor of the El Centro proving ground.



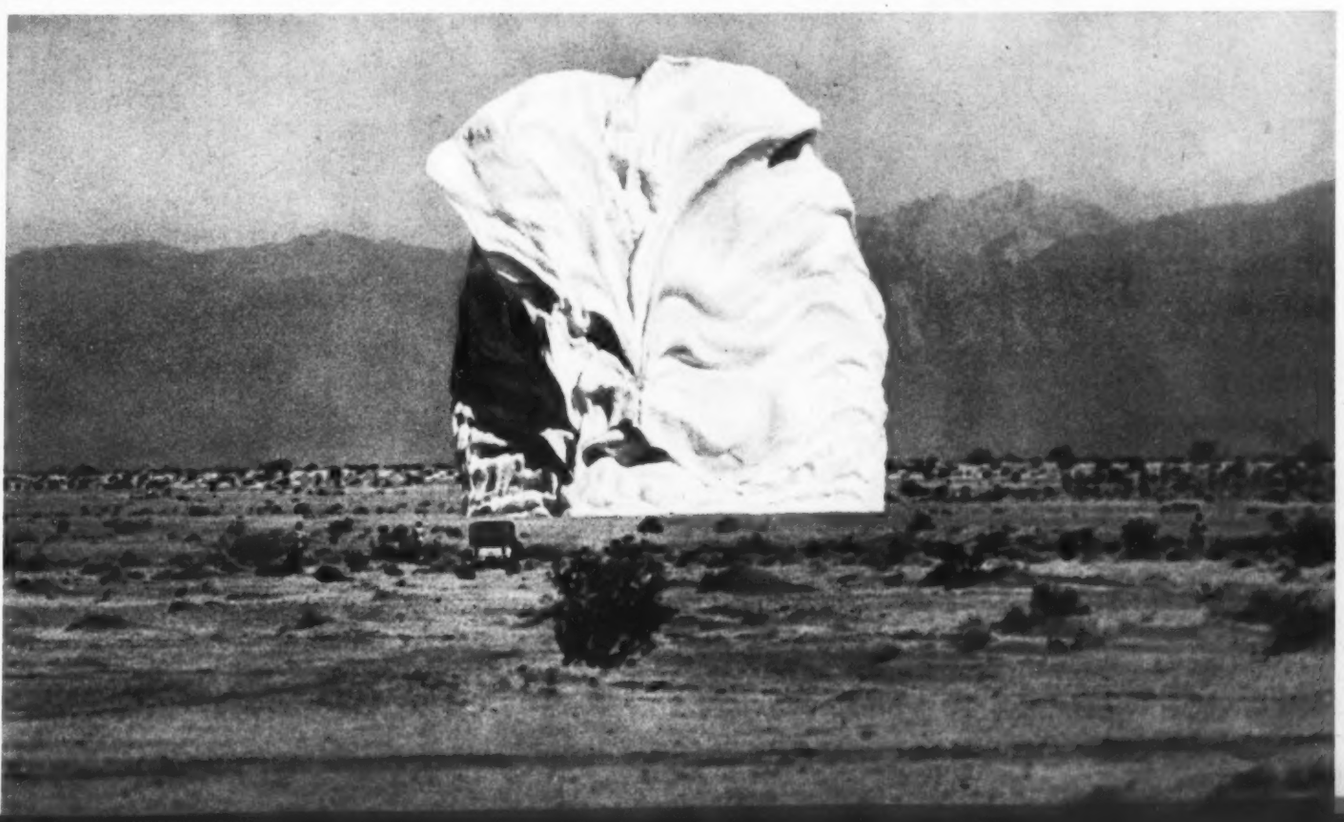
In the new tests parachutes of *200 feet diameter* were used to drop test loads of 12,000 pounds of cement and lead from heights of about 2,300 feet. At the same time, secondary tests were demonstrated, in the course of which two 100-foot 'chutes were used together, presumably to drop loads of similar weight.

The big 'chute is quite experimental, and officials are still theorizing that smaller ones, or clusters of them, may prove more practical than the very large ones. However, a military load of 12,000 lbs. can represent a pretty hefty piece of equipment—a large truck, or a gun, or a substantial supply of ammunition. The load would have to be suitably shored, possibly with crushable impact boards and flooring, so as to absorb the shock of the descent speed, which approximates that of a man-carrying 'chute.

The big 'chute takes three-quarters of an acre of fine Nylon to make and undoubtedly is the largest ever built.

The pictures on these pages show the "chain reaction" of a 12,000-pound drop from a Fairchild "Packet" cargo transport with a 200-foot parachute, 2,300 feet above El Centro.

Contact! . . . The big load is safely landed, and automatic cutters have freed it of the 200-foot shroud lines of the 200-foot parachute which is seen collapsing in a white billow somewhat reminiscent of the burst of an atom-bomb. Note the comparative size of test center personnel rushing across the desert to the landing spot. The parachute is several times as big, in area covered, as the "biggest" built privately two decades ago by a designer named Broadwick, in conjunction with Walter T. Varney, pioneer U.S. air mail contractor (Varney Air Lines). Varney lowered a piloted JN-4-D aircraft under his 'chute. The 'plane suffered only a broken landing gear in the landing impact. Varney contemplated attaching such parachutes to all his mail planes in the Pacific Northwest but failed to follow through on the idea.



Where are America's jet transports? (II)

In the two months since *Interavia* last attempted to answer this question[1] things seem to have started moving in the American civil jet transport field. While until quite recently the U.S. Congress, the airlines and the aircraft industry rejected the idea of Government assistance in the development of U.S. civil jets[2], this attitude has now changed quite radically—probably partly due to the fact that BOAC's "Comet" operations to South Africa and the company's plans to expand them to the Far East in a few months' time are, after all, proving to be something of a headache to U.S. airline operators.

In the middle of May Donald W. Nyrop, Chairman of the U.S. Civil Aeronautics Board, presented a proposal to Congress under which the CAB would underwrite the cost of developing an American-designed jet transport—estimated at about $20,000,000—to the tune of 75%, or $15,000,000. The plan also provided for operational subsidies of $1,000,000 for each aircraft during a one-year testing programme.

This is a revolutionary idea for a private enterprise-minded country like the U.S.A., and the significant thing is that in the middle of June the U.S. aircraft industry, speaking through the Aircraft Industries Association, *expressed its approval of the project.*

Meanwhile, the incredible game of guessing which of the major U.S. manufacturers will be the first publicly to announce his latest creation is still going on. Douglas, Lockheed, Boeing ? The companies themselves won't tell. In reply to a direct enquiry by *Interavia,* Douglas Aircraft states that the company is "actively and most satisfactorily progressing in its jet transport project"; Lockheed Aircraft says that its "work on jet transport designs is a matter of record, and the company has been in contact with airlines regarding them." Both added that no details could be released.

How wide open the jet transport field still is in the United States became apparent in mid-June, when *Interavia* learned, reliably and exclusively, that a comparative outsider was getting ready to join America's jet transport trio, Lockheed, Douglas and Boeing. The "dark horse" is *North American Aviation, Inc.,* of Los Angeles, which is rapidly completing the designs for a tapered swept-wing, 80-passenger four-engined transport jet cruising at 600 m.p.h.

North American is one of the biggest U.S. aircraft manufacturers, whose main characteristic is the fact that its shrewd chairman, James Howard ("Dutch") Kindelberger, long ago hitched his wagon to a military star. His only contacts with civil aircraft were twenty years ago when he was the man supervising the engineering side of the Douglas DC-1, grandfather of all Douglas transports, and after World War II when his company developed the "Navion" personal aircraft. He lost money on the latter project—and promptly sold it—but apart from that he has been one of the industry's most consistent money-makers.

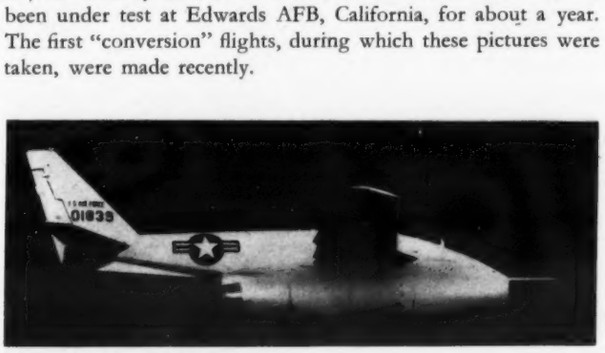
Like the other manufacturers, "Dutch" Kindelberger isn't ready yet to announce details of his jet transport project. But his entry into the ring will make the competition even keener. The winners of the race stand a good chance of catching up Britain's present jet transport lead and retaining America's preponderance in the world's commercial transport aircraft market.

[1] Cf. INTERAVIA REVIEW, No. 6, 1952, pages 312-313.
[2] Cf. INTERAVIA REVIEW, No. 5, 1952, pages 257-258 : "No Subsidized Transport Aircraft for the USA."

Bell X-5

Variable Wing Sweep

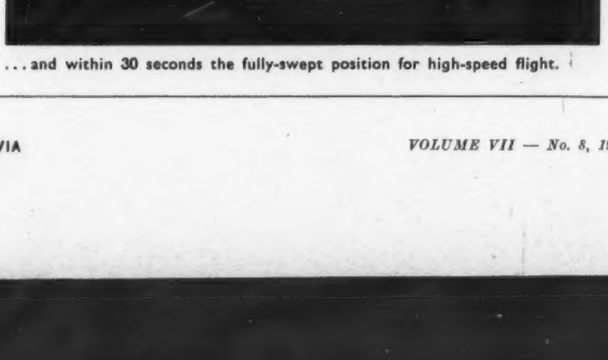
Within thirty seconds and at full flying speed the wings of the Bell X-5 experimental aircraft can be moved from their normal position of medium sweep to a sharply-swept setting. This is done by means of a powerful mechanism inside the fuselage. The "convertible" aircraft, which spans 32 ft. 9 ins. and has a length of 33 ft. 4 ins., is fitted with an Allison J-35 jet engine, whose latest model delivers a static dry thrust of 5,600 lbs. After three years of joint effort by the U.S. Air Force, NACA and Bell, the X-5 has been under test at Edwards AFB, California, for about a year. The first "conversion" flights, during which these pictures were taken, were made recently.



In normal flight with slight sweep ...

... the Bell X-5's wings are moved backwards.

Within 15 seconds they reach the half-way mark ...



... and within 30 seconds the fully-swept position for high-speed flight.

Navigator or no Navigator?

The "North Atlantic Jubilee" issue of *Interavia Review* (May, 1952) contained a brief article by Captain Adrian Viruly, Chief Pilot of KLM-Royal Dutch Airlines, describing "A Typical North Atlantic Air Crew," flying from Amsterdam to New York on March 15th, last, the day which *Interavia* had chosen at random for a study of airline operations over the North Atlantic. Captain Viruly, who is not only a veteran pilot but also an author of distinction, mentioned that KLM does not carry a special navigator on its long-range flights. "... A quarter of a century has elapsed since Lindbergh's unique achievement, and flying across the immense waters of the Atlantic Ocean is now a routine matter, no longer calling for the rare ability of a Lindbergh. The pilots can navigate, of course, each in turn. A little mental exercise does not come amiss, and none of the three would wish it otherwise, for it helps to pass the time..."

The question of whether long-range aircraft should carry a special navigator or not has long been a subject of controversy, and Captain Viruly's negative view seems to have roused the ire of Mr. Fred Wirth, Secretary-General of the International Airline Navigators' Council, whose letter to the Editor is printed below. The Council obviously seeks to protect the interests of the airline navigators—interests which have come under fire more than once. Of the eleven IATA North Atlantic operators, three carry no separate navigators (PAA, KLM and LAI). As long ago as 1948, both PAA and BOAC were making plans to revert to their pre-war practice of assigning navigational functions to co-pilots and of dispensing with their non-pilot flight navigators. PAA went as far as discharging some of its navigators—which nearly resulted in an on-the-spot navigators' strike. The company succeeded in averting the walk-out, but in the meantime it has nevertheless enforced its plans.

Mr. Wirth's letter and Captain Viruly's reply follow.—Ed.

THE EDITOR,
"INTERAVIA, REVIEW OF WORLD AVIATION,"
GENEVA 11

Sir,

In the May, 1952, issue of *Interavia* I read a number of articles on North Atlantic flying, including one written by Captain Adrian Viruly of KLM under the title "A Typical North Atlantic Air Crew."

I was astonished to note that *Interavia*, as a magazine of Swiss origin, must gather information of this sort from a non-Swiss enterprise, especially since "Swissair" also operate over the North Atlantic and could equally well have supplied you with the material you needed.

However, I was even more astonished by the views expressed by KLM-Captain Viruly, who in spite of a 25-year career in aviation displays unequalled ignorance in his discussion of the various functions of the individual members of an Atlantic air crew (particularly those of the Navigator and Radio Operator).

It is to be regretted that by reproducing Mr. Viruly's comments, *Interavia* has published an article which—particularly as regards the position of the navigator—distorts the facts and gives the reader a completely false impression of the composition of a typical long-range air crew. The following international airlines, whose schedules include services from Europe to the USA and/or Latin America, today employ specially trained navigators aboard their aircraft:

Argentine Airlines	(Argentina)
Air France	(France)
BOAC	(Britain)
El Al	(Israel)
Flying Tiger Lines	(USA)
Iberia	(Spain)
SAS	(Scandinavia)
Sabena	(Belgium)
Seaboard & Western	(USA)
Swissair	(Switzerland)
Trans Canada Airlines	(Canada)
Transocean Airlines	(USA)
Trans World Airlines	(USA)

For navigation duties Pan American Airways employs a supplementary pilot who devotes his time exclusively to navigation throughout the whole trip. (The advantages of this method are debatable, particularly so far as the smaller operators are concerned, and according to American experts the arrangement is unfavourable from a financial point of view).

KLM-Royal Dutch Airlines uses—as described in your article—three pilots on the North Atlantic, without a separate navigator, and the three pilots take turns at carrying out the functions of the navigator.

Judging by what Mr. Viruly has to say, it almost seems that KLM's pilots use their mental equipment only while navigating and enjoy this "little game" to pass the time. Aircraft captains of other companies are constantly aware of their very responsible position from the beginning to the end of any long-range flight and must continuously supervise the collaboration between the members of their crews.

Maximum safety and punctuality in airline operation can be obtained only through the closely integrated work of specialists, and in this connection it is not possible lightly to wave aside the contribution of the navigator. The safety factor especially is of the greatest importance not only to the passenger, but also to all airline operators who today are strenuously competing with each other.

On behalf of the President and members of the *International Airline Navigators' Council* I must therefore protest against the statements of KLM Chief Pilot Viruly.

We should be grateful if you would inform your readers of our observations.

Fred Wirth,
NAVIGATOR,
SECRETARY-GENERAL,
INTERNATIONAL AIRLINE NAVIGATORS' COUNCIL.

Zurich, Switzerland

And here is Captain Viruly's reply:

Sir,

It does not make me happy to take up arms against Mr. Fred Wirth, in the first place because I think that to take up arms is very seldom a good idea, in the second place because I have always felt very warmly towards Swiss airmen since the early days, when I translated with so much pleasure those excellent books of the late Captain Ackermann[1] into the Dutch language. Still, if *Interavia* wants my personal opinion on his letter, I am willing to give it, but I wish to stress that my view *is* personal and should not be regarded as an official point of view of KLM.

When I was flying on the North Atlantic in 1942 I was all in favour of carrying special

[1] The name of Walter Ackermann deserves to be written in the golden book of aviation history. A Swissair corps officer and for many years flight captain with Swissair and its predecessor companies, Walter Ackermann was killed at the age of 36 at the controls of a Junkers Ju-86 (with Diesel engines) in July 1939. Known beyond the frontiers of Switzerland as an international flyer and beloved for his personal charm, he also achieved international fame through his books. There can scarcely by a more amusing book of memoirs than "Bordbuch eines Verkehrsfliegers" (Log Book of a Commercial Pilot). "Flug mit Elisabeth" (Flight with Elizabeth) shows the true poet, and his "Flieg mit!" (Come and Fly) is the most attractive of books for young people. These books are still widely read, and have been translated into several foreign languages.

navigators on the "Liberators" of those days. I also expected that the job of navigator would develop into an important profession in its own right. For it was the time of low true air speeds, large drift angles, not too large reserves of petrol, no Loran, no weather ships, no radar screens on such ships, no pressure pattern navigation, doubtful weather forecasts, astronomical fixes that took nearly half an hour . . . the supermen behind the plotting map had quite a job and I was constantly sorry that every hour did not have at least 70 minutes.

All these factors have changed considerably. Would Mr. Wirth carry a special navigator to cross Lake Geneva ? Especially when there is an ILS beam to guide the pilot straight into Geneva Airport at Cointrin ? No, he would not. Does he think that a special navigator is required to cross the North Sea? I am sure he does not. Do I feel that, in 1952, we need one between Prestwick and Gander or even above the lonely spaces between Kano and Tunis ? I certainly don't.

Mr. Wirth is of the opinion that I am speaking from "unequalled ignorance." He may indeed know more about these things than I do: all knowledge is of relative value and so-called scientific truths seldom last very long. My opinion is based upon the experience of 18,000 flying hours and twenty years of long-distance navigation, chiefly with KLM and chiefly over water. It makes me think that navigating our current types of large aeroplane should be done by pilots, that this is part of their profession, that the First Class Navigator's ticket, which they should hold, should guarantee their full proficiency (as far as any scrap of paper in this world can guarantee anything), and that it is very good policy for an airline to give their younger pilots a thousand hours or more behind the navigation desk: that will make them better captains than they could ever hope to be without such experience.

I do not know in detail how other airlines solve the problem. At KLM we have about ten non-pilot navigators who are partly instructors at our Navigation School where all pilots have to go. They also serve aboard our aeroplanes from time to time so as to stay in close contact with operations. Generally, the captain decides before the flight which of the pilots shall do the navigation and for how many hours. Thousands of flights across the North and the South Atlantic, across the deserts and even about two hundred flights from Mauritius to Java (2989 n. miles across open sea without Loran help) have been carried out this way, and I do not know that the system has ever made anybody sorry. On the contrary: it is good to know that on every long distance flight three men on board can navigate well, as they have passed through an excellent Long Distance Navigation School and have hundreds and hundreds of hours of practical navigation behind them.

Mr. Wirth's experience may entitle him to express a better judgment than I could give. I have never felt that the captain of an aircraft between, say, Shannon and Gander should have to neglect any of his duties when he does about three hours or so of navigation—except that he does not sit behind the automatic pilot and watch a crowd of crew members while regretting in mournful meditation the times in which he was stewardess, steward, flight clerk, radio operator, engineer, navigator and captain all-in-one. If Mr. Wirth does not understand this, Captain Ackermann would: he would at any time have preferred a "Flight with Elizabeth" (title of one of his books.—*Ed.*—) to any flight with any of those too many male experts of today.

Adrian Viruly
CHIEF PILOT, KLM

The Hague, Holland

The Air Hostess Told Us...

Associated Press Wirephoto

Straight Up

England's flying triangle, the Gloster GA-5 "Night Watchman," goes straight up during a recent test flight. The twin-jet plane will be mass produced as a standard night fighter for the Royal Air Force.

As INTERAVIA's millions of avid readers know, Esmeralda, our Favourite Air Hostess, reconciles a number of quite irreconcilable characteristics. She is good-looking and has allure; she also is intelligent. She is as shrewd as they come, and yet she has retained a kind of open-minded frankness which often borders on credulity.

The other day she breezed into our hot July office and said—you're behind the times, you haven't reported this year's most revolutionary, phenomenal aviation development. And what would that be? we enquired, trying to be as sarcastic as possible.

I knew you wouldn't know, said Esmeralda, somewhat out of context, but I'll be a nice girl and tell. You and I, she declaimed, have seen all those pictures of jets climbing vertically into the air. But what you haven't seen is a jet going straight-up . . . backwards, and hereby I inform you that such a thing has been invented. Just think of it, she said dreamily . . . but we interrupted her rudely. Come, come, dear girl, we said, somebody's taking you for a ride: that doesn't exist. I knew you'd be acting stupid, she retorted, that's why I brought documentary evidence with me . . . *voilà*, as we college persons put it, from *The Washington Post*, June 8th, a most reliable newspaper, you'll admit.

We looked at the cutting before us. There it was, Britain's new Gloster GA.5 twin-engined delta fighter, nose at the bottom of the picture, jet pipes at the top, captioned "Straight Up." Here you are, said Esmeralda, *per ardua ad astra*—tail first, as I told you. Why not ? They've been using reversible propellers for years, and now they've got reversible turbines. Just imagine the shock of a MiG pilot if he sees one of these kites arrive at top speed, stop in mid-air, fire a few shots, and retire gracefully backwards through the sonic wall ?

We give up, we said. Don't you see that the crate is really going up *nose-first*, but that the man in the printing shop put the plate in upside-down ? Well, he ought to be fired, said Esmeralda indignantly, for spreading false propaganda, like in Russia. Better ring up the *Washington Post*, we replied, and ask them what they've done to him.

What's in the Air ?*

SERVICE AVIATION

● *Aircraft losses in Korea.*—Combat statistics from Korea published in mid-June by the U.S. Air Force revealed that the United Nations forces had lost 1,427 aircraft since the outbreak of the Korea conflict. The U.S. Air Force had lost 570 (including 261 jet aircraft), the U.S. Navy and Marine Corps 797 and other Allies 60. Estimated North Korean aircraft losses were 473, including 328 MiG-15 jet fighters.—The present aircraft strength of the U.S. Air Force is estimated at 8,000 frontline aircraft (cf. "The West Turns out its Pockets," Interavia No. 7, 1952, pp. 364 et seq.).

● *U.S. Bases.*—President Truman has asked the American Congress for *supplementary appropriations* amounting to $3,463,555,440 for the 1953 fiscal year (beginning on July 1st, 1952). Of this sum approximately $3,000,000,000 is to be for bases at home and abroad, $400 000 000 each for Army and Navy, *$1,500,000,000 for the U.S. Air Force,* $650 000 000 for the Department of Defense for the establishment of overseas bases.

● *U.S. Air Force Personnel.*—The Air Surgeon of the U.S. Air Force reveals that roughly 12,000 persons had to be released from the service during 1951 for health and other reasons. This figure includes over 3,000 cases of new recruits whose health or character defects were not revealed in their original physical examinations.

● *Canadian jet fighters cross Atlantic.*—On May 30th the RCAF's No. 439 Squadron, equipped with F-86 "Sabre" jet fighters built under licence by Canadair Ltd., flew across to Britain. The "mother ships" on this *first trans-Atlantic flight by Canadian-built jet aircraft* were Canadair "North Stars."

● *Guided missiles for Swedish Coastal Artillery.*—Major-General Hjalmar Åström, Commanding Officer of the Royal Swedish Coastal Artillery, has revealed that his heavy batteries are to be replaced by "*robot batteries,*" to cover considerable areas of the Gulf of Bothnia and the Baltic.

● *Finnish Air Force.*—According to a press statement by Rear-Admiral Sundman, head of Finland's reparations commission, Finland has already paid off 97.9% of her reparations debt to Russia, and the remainder will be paid by the middle of September. The country can now set itself to the *reorganization of its Air Force,* which has had no new equipment since 1944 (maximum strength then permitted 60 aircraft).—It is reported that a first order for some 30 to 50 Valmet "Vihuri" single-engined fighter trainers (with Bristol "Mercury VIII" piston engines built in Finland) has been placed with the Aviation Division of the Finnish State Metal Works. The "Vihuri" was test flown in the spring of 1951.

Air Chief Marshal Sir William Dickson, of RAF Bomber Command, has been appointed *Chief of the Air Staff* from January 1st, 1953, in succession to Marshal of the Royal Air Force Sir John Slessor, who retires from active service at the end of 1952. *(Photo : Crown Copyright).*

AIR TRANSPORTATION

● *End of fuel restrictions.*—The American oil strike came to an end on June 2nd, and world air traffic gradually resumed full operations, so that by June 15th the situation was back to normal.

● *Reducing the paper war.*—A survey of 133 countries made by the International Air Transport Association reveals a reduction in the paper work required for air freight carriage. The International Cargo Invoice has been adopted by 54 countries, four others require no special papers, 67 accept a basic commercial invoice and only 10 demand an additional paper with the invoice.

USA

● *Air mail boom.*—According to a recent estimate by United Air Lines, leading air mail carrier in the United States, approximately 40,000,000 ton-miles of mail will be carried by all American airlines during 1952. In other words each of the 40,000,000 families in the United States sends an average of one air mail letter a week over a mean distance of 1,200 miles. There are also 30,000,000 ton-miles of air parcel post.

● *Pan American Airways* flew a total of 34,833,000 passenger-miles during the first quarter of 1952 (compared with 31,467,000 in the corresponding period of last year), making this the best quarter in the company's history.

● *No all-cargo cut rates.*—The U.S. Civil Aeronautics Board has refused applications by Seaboard & Western Airlines and Transocean Airlines for authorization to run cut rate all-cargo services between the United States and Europe, the Middle and Far East. CAB claimed that such services could not be operated profitably.

● *New "Private airline" policy in Britain ?*—The British Government's new policy for civil aviation does not appear to grant the private airlines quite the advantages they had hoped.

a) New scheduled overseas services are to be open to both Corporations and private carriers alike (licences granted by the Air Transport Advisory Council) ; *b)* Corporations no longer to keep aircraft specifically for charter ; *c)* private airlines may open domestic services (including services to Scotland, the Channel Islands, the Isle of Man), provided they do not affect BEA's network.

● *Prague—Peking.*—A recent air agreement between Czechoslovakia and the USSR authorizes the Czech national airline, CSA, to fly over Russian territory on its Prague—Peking services—*the only air link at present between Europe and Communist China.*

INDUSTRY

American arms aid

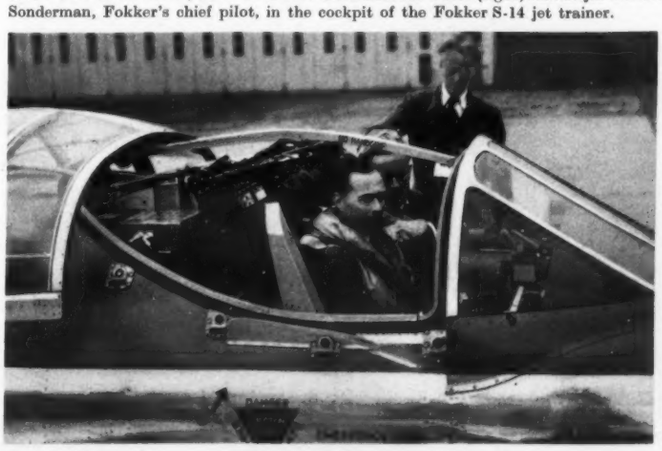
● On June 9th the American Senate adopted the bill authorizing continuance of arms aid to friendly nations, under the "*Mutual Security Act of 1952.*" As the House of Representatives has already approved the sum of $6,447,000,000 for this purpose, the bill was then passed to President Truman for signature. Economic and technical aid (starting up the armament industries) will take another $1,805,000,000.

● During the *budget debates in the French National Assembly* Pierre Montel, Secretary of State for Air, stressed the *decisive importance of American "off-shore contracts"* to the French economy. He stated that if American orders were withdrawn France's whole external and military policy would have to be drastically recast.

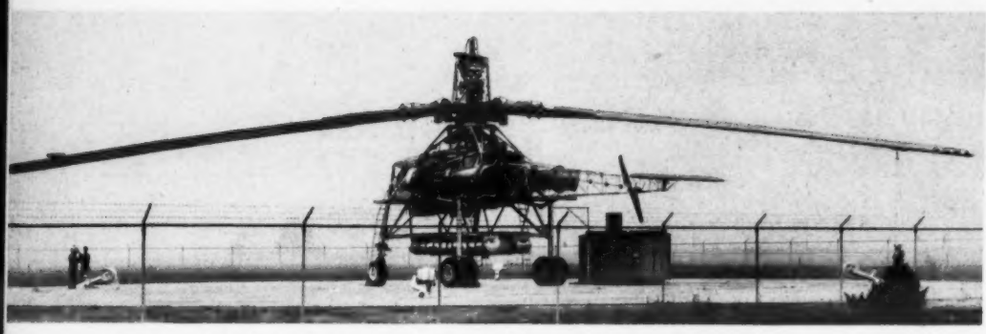
● In mid-June U.S. Air Force Headquarters in Wiesbaden placed an order with the *Ford S.A.F. in Paris* for $4,000,000 worth of jet starters for Republic F-84 "Thunderjets" stationed in France. This was the second multi-million dollar contract awarded by the USAF within a week for the production of "Thunderjet" parts in Europe. The first order ($5,000,000) was for airframes, to be produced by Italian firms affiliated to *Finmeccanica.* Altogether USAFE has so far placed orders for parts with over 3,500 European firms.

* Extracts from INTERAVIA AIR LETTER, daily international news digest, in English and French. All rights reserved.

Lieut.-General I. A. Aler, Chief of Staff of the Dutch Air Force (right) and Major Gerben Sonderman, Fokker's chief pilot, in the cockpit of the Fokker S-14 jet trainer.



During his talks in Washington French Minister of State Letourneau obtained a considerable increase in American arms aid for Vietnam.—Vietnam parachutists shortly before landing ("Chaumière" exercise) in the North-East of the Province of Tay-Ninh.



Prototype of the Hughes XH-17 "Giant" helicopter built by the Hughes Aircraft Co., Culver City California, ready for flight tests.

USA

● *Resuscitation of the Prototype Bill?*—It was reported in the July issue of Interavia that the U.S. Civil Aeronautics Board was asking for Government subsidies for the development of jet airliners, despite the opposition of large parts of the American industry. Faced with the rapid progress of development in Britain even the industry now appears to have overcome some of its objections. Admiral Dewitt C. Ramsey, President of the Aircraft Industries Association, told the Senate Commerce Committee that the "majority of the views of manufacturers concerned favours" CAB Chairman Donald W. Nyrop's plan (Government loan of 75% of development costs; loan to be wiped out if at least 15 aircraft are sold).

France

● *SNECMA out of the red.*—SNECMA, the French nationalized engine producer, closed the 1951 business year with a *net profit of 102,400,000 francs* (after allowance for depreciation and reserves). As sales amounted to rather more than 10,000,000,000 francs, the profit figure represents only 1%, but after four years of losses the balance sheet marks a welcome turning point. Repayment of long-term Government loans began early in 1952. On January 1st, 1952, SNECMA employed 8091 persons.

Japan

● In conformity with the provisions of the peace treaty the headquarters of the U.S. Occupation Forces has announced that *850 armament works* originally earmarked for reparations are to be returned to the Japanese *Government*. These include 314 aircraft and equipment factories, 131 Army and Navy arsenals, 25 aeronautical and armament research institutes, etc. Some of the plants will still remain, however, under American control, in accordance with the terms of the Mutual Security Pact.

The American share in this reconstruction has been referred to repeatedly. It now seems that the British are also taking an interest. According to a report from Interavia's correspondent in Tokyo, Captain K.J.G. Barlett, Commercial Manager of the Bristol Aeroplane Co., had preparatory talks, during his stay in Japan, with representatives of some of the famous World War II firms, such as Kawasaki, Mitsubishi, etc.

FLYING EQUIPMENT

USA

● The first *Lockheed R7V-1- "Super Constellation"* four-engined transport for the U.S. Navy (3250 h.p. Wright R-3350 "Turbo-Cyclone 18" compound engines) is to begin flight tests in August 1952. The Navy has ordered a large number of these aircraft, which can be used for the carriage of passengers (106 seats), as a hospital aircraft (73 stretcher cases) or for cargo service (approx. 15 tons). In addition to the R7V-1, there are also two "Super Constellations" of the R7V-2 version with propeller turbines under construction for the Navy.—The first civil "Super Constellations" with Wright compound engines are to be delivered to KLM Royal Dutch Airlines early in 1953.

● Although no official confirmation has been received, it is assumed that the new *Grumman XF10F-1 "Jaguar"* carrier-borne swept-wing jet fighter for the U.S. Navy has been flight testing for some time. The "Jaguar," a heavy and extremely efficient carrier fighter, is fitted with a Westinghouse J-40 jet engine of approximately 7500 lbs. static thrust. The wing's angle of sweep can be varied in flight.

Great Britain

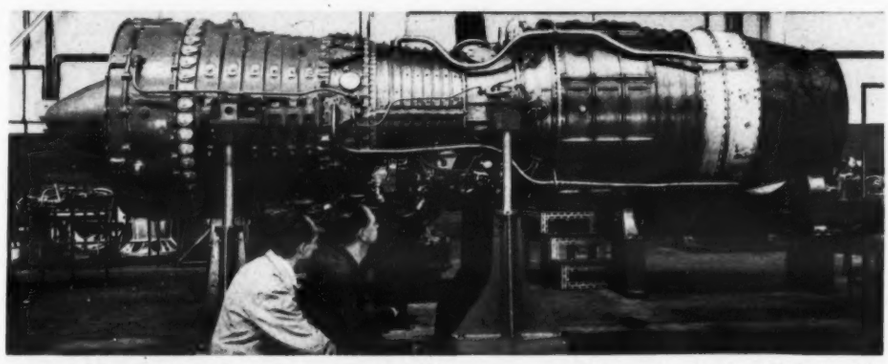
● The first production models of the *Vickers Supermarine "Swift"* single-engined jet fighter are expected for 1953, and the first production models of the *Hawker P.1067 "Hunter"* for 1954.

● Following the satisfactory performance of the *Vickers-Armstrongs "Valiant"* four-jet bomber, the producers have been granted a development contract for other aircraft in this class.

● Two *delta-wing trainers* are under development at *A.V. Roe & Co.*—Two-seaters, with very much the same design as the Avro 707A experimental type, they are probably to be fitted with Rolls-Royce "Derwent" jets.—The *prototype of a high-performance bomber*, announced by A.V. Roe for September, is probably the four-jet delta-wing bomber; no confirmation of this assumption is available however.

France

● The extensive production programme of *Etablissements Fouga & Cie*, Aire-sur-l'Adour, shows that a first small series of *Fouga "Midjet"* racing aircraft (Turboméca "Palas" of 350 lbs. static thrust) has been built and tested.—The prototype of the *Fouga CM.170 R* twin-jet two-seater trainer (Turboméca "Marboré II" turbojets with a total of 1470 lbs. thrust) has started flight tests. Finally the Fouga works are also building the *"Sylphe III,"* a light jet aircraft for transition training of glider pilots, high-altitude practice flying, etc. The "Sylphe III" (Turboméca "Piméné" of 220 lbs thrust) is derived from the well-known "Sylphe I" and "II."



Bristol "Olympus" high-performance two-spool gas-turbine engine: diameter, 40 in.; length, 124 in.: weight, 3,520 lbs.; maximum static thrust, 9,750 lbs.

Italy

● *Caproni* has started flight testing of the prototype of the *Aero-Caproni F.5* (Turboméca "Palas") two-seater trainer. (Designer: Engineer Stelio Frati.)

ENGINES

France

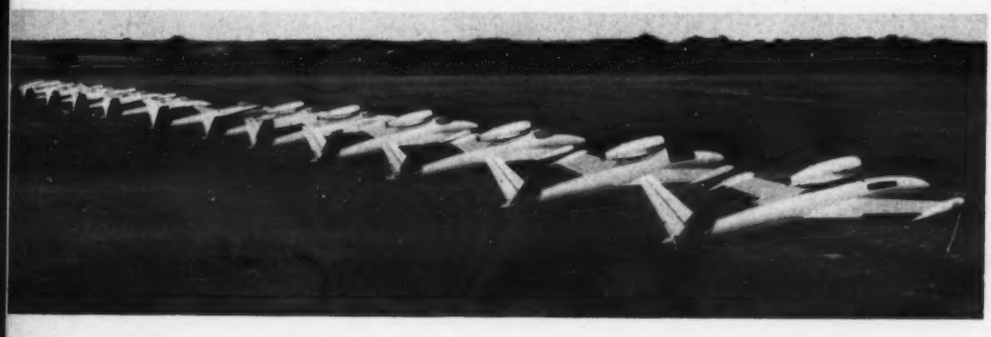
● First bench tests of the *SNECMA "Vulcain"* (10,000 lbs. thrust class) have been made.—SNECMA also reports that development of the SNECMA TB.1000 and TB.1000A propeller turbines (and the projected derivative TB.1000B of 2,500 s.h.p.) has been suspended for reasons of economy, in spite of the fact that the engines figure in the Five-Year Plan.

● One of the most powerful jet engines is under development at *Société Rateau*. Designated the *Rateau SRA 301 "Berry,"* it is to have a static thrust of approximately 19,800 lbs.

Sweden

● *Svenska Turbinfabriks A.B. Ljungström (STAL).* Finspong, one of Sweden's leading turbine producers, has for some time been working with *Svenska Flygmotor A.B.*, Trollhättan, on a high-performance axial compressor jet engine. The engine is known as the "Dovern" (name of one of the numerous lakes in the Finspong area). A prototype of the "Dovern" has had several months' tests in a "Lancaster" bomber arranged as a flying test bench, and is now ready for quantity production. As regards performance the "Dovern" is said to be the equal of the most powerful turbojets of American, British or French design. A fighter (successor to the Saab-29) under development at Svenska Aeroplan A.B., Linköping, will probably be fitted with the new engine.

Fouga's airfield at Aire-sur-l'Adour (Landes). Light jet aircraft, with Turboméca engines, for military training, sports and research purposes (high-altitude flight).



The Problem of Drag [1]

by Dr. F. Riegels, Göttingen.

It is said that the present century is the century of aviation. From the scientific and technical standpoint this is reflected in the constant struggle connected with the lift and drag of bodies. Every increase in speed and range, however slight, is fundamentally a victory in drag research. It would therefore be well to draw up a kind of balance sheet of what is known *for certain* today. It is consequently my intention to give a general account, in the limited space available, of what is known today on the laws of drag, in particular the behaviour of a body in incompressible and compressible flow. Incompressible flows include air whenever it is a question of speeds well below sonic speeds.

Sub-critical and super-critical flow

I should first like to recall that in slow flow caused only by the forces of viscosity, the laws of drag are known both theoretically and experimentally. In this case the forces of inertia operating in the flow are extremely small compared with the friction. This also finds expression when we say that the ratio between these two forces in incompressible flow, the so-called *Reynolds number* (abbreviation *Re*), is low. An increase in the Reynolds number first produces symmetrical changes in the streamline configuration on the back of the body, which finally, at about $Re = 100$, leads to the break-away of vortices from either side alternately, and finally to very regular von Kármán vortex streets *(fig. 1)*.

If the vortex frequencies obtained experimentally are plotted against the Reynolds number, there is seen to be a clear connection with the law of drag in the sense that an increase in the non-dimensional vortex frequency nd/v (d = diameter of cylinder, v = velocity of flow) is bound up with a reduction in the drag coefficient. This is to be observed in both the *Re* number range between 10^2 and 10^3 and that between 10^5 and 10^6, the so-called critical *Re* number range.

In the latter range vortex frequencies increase very markedly, and there is also a noticeable change in the flow configuration, which finds external expression in a strong reduction in the wake *(fig. 2)*.

Prandtl was able to show that the origin of all these break-away phenomena is to be found in the boundary layer, that is in the thin layer on the body in which velocity increases from zero to the local velocity of flow. This layer, greatly delayed by friction on the skin of the body, is not capable of overcoming the pressure rise at the rear part of the body's surface and therefore breaks away. If this break-away occurs while the boundary layer is in laminar flow a broad wake is formed, with Kármán vortices. This is then known as a sub-critical flow. If, however, there has already been a transition to turbulent flow in the boundary layer, break-away from the surface of the body takes place later, the wake is smaller, and the flow is known as super-critical.

The great differences in the magnitude of drags for different types of bodies are important. With the squat body with blunt or rounded rear, drag is determined in essentials by the wake : they have primarily pressure drag, and the proportion of friction drag plays only a small part in comparison (for a circular cylinder, for example, between 1 and 2 % of the total drag). For slender bodies

[1] From a lecture at Brunswick Polytechnic during the re-inauguration of the WGL (Scientific Society for Aviation) on April 21st, 1952.

Fig. 1 : Flow round a cylinder and formation of eddies at various Reynolds numbers.

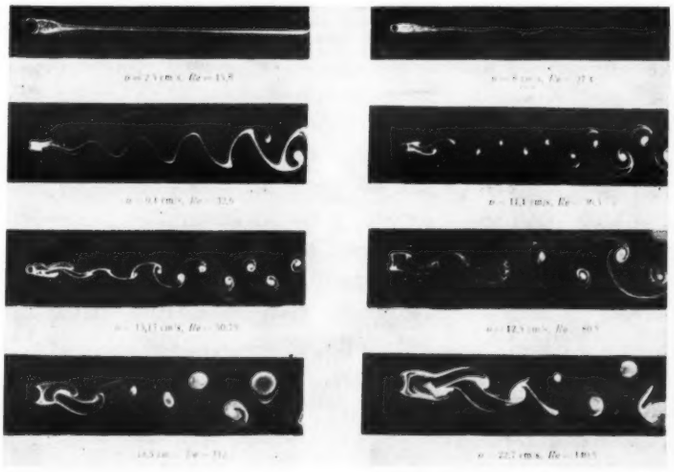
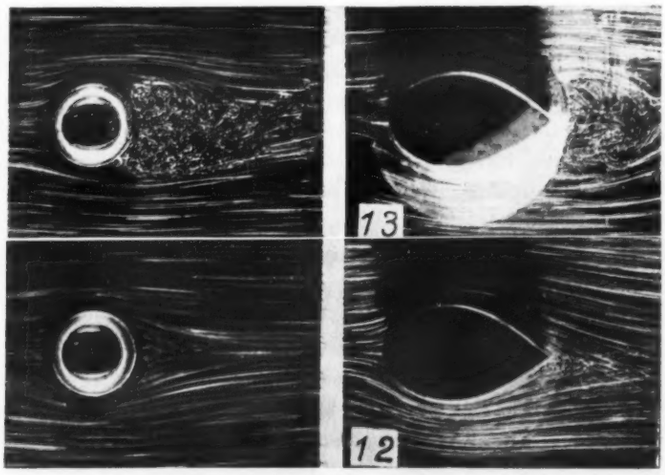


Fig. 2 : Sub-critical and super-critical flow round a sphere and a profiled body.



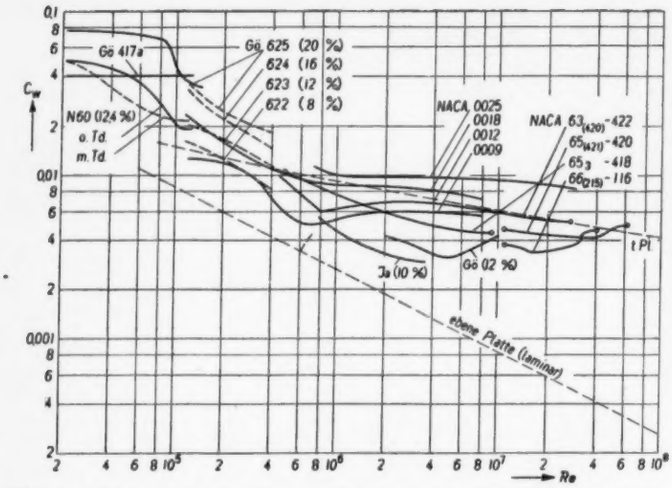


Fig. 3 : Minimum profile drag coefficients as a function of the Reynolds number.

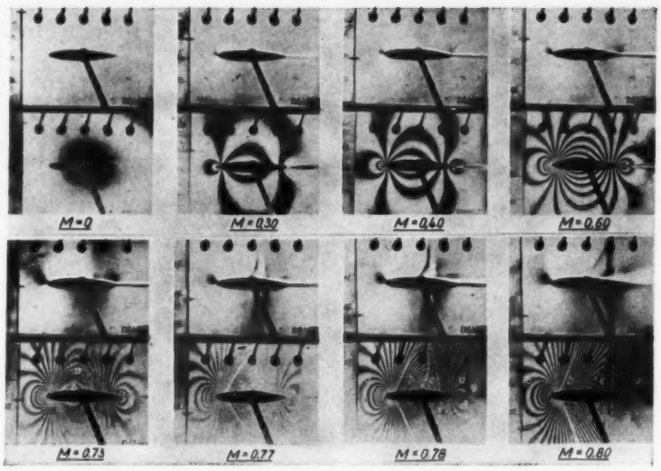


Fig. 4 : Schlieren and interference photos of compressible flow round an airfoil (Zobel, 1944).

and higher Reynolds numbers pressure drag can, however, be greatly reduced by suitable design and finally reduced to a minimum. Friction drag then becomes very much more important, but is considerably lower if the boundary layer can be kept laminar as long as possible. This is the reason for the tremendous efforts that have been made during the past two decades in the scientific and technical field to solve the problem of transition from laminar to turbulent flow.

Laminar flow airfoils

Closely connected with the above is the highly interesting story of the development of more modern airfoils, the so-called laminar flow airfoils. The fact that these airfoils are today used in all the more recent aircraft projects designed for flight at high Reynolds numbers proves that the transition problem is now under control from the quantitative point of view. Some examples of minimum profile drag obtained in wind tunnel experiments are shown in *fig. 3*. For purposes of comparison the laminar and turbulent drag of a plate with longitudinal flow—i.e., pure friction drag—are also shown.

At low Reynolds numbers it is seen at first that normal airfoils behave like less slender bodies, except that the critical Reynolds number is very much lower. By artificially producing turbulence in the boundary layer with the aid of a *turbulence wire* (Td), stretched in front of the stagnation line, the critical Reynolds number can be shifted still further forward and drag thus slightly reduced (cf. curve N 60 with Td). This fact is of the utmost importance in model flying but has hitherto scarcely been utilized.

Following a number of Göttingen propeller profiles in the super critical range, there are the normal NACA four-figure airfoils, whose drag coefficient plotted against the Reynolds number clearly shows the large part played by friction drag. The maximum thickness of these airfoils is at approximately 30 % of the chord and the "normal" leading edge radius (in relation to the airfoil chord) is equal to 1.1 times the square of the thickness ratio. In these airfoils the point of transition is in the forward third of the chord.

The remaining measured values entered are more recent results from laminar flow airfoils, i.e., those with transition points shifted far back. All date from within the past ten years. The great progress that has been made is clearly recognizable. The minimum drag (for example, for an airfoil of 18 % thickness ratio at $Re = 5 \times 10^6$) has been reduced to about half what it was for the usual airfoil before World War II. Characteristic of modern airfoils are pressure distributions with a pressure drop roughly in the region of the maximum thickness, followed by a powerful pressure rise. Geometrically, these considerations lead to airfoils with maximum thickness shifted back, about ½ to ¾ normal leading edge radius and, a very important point, to a small trailing edge angle.

A particularly interesting point is that it is only the efficiency of modern theory that has made possible this progress and has thus created a close connection between theory and practice. In fact it is no longer a problem to calculate pressure distributions, boundary layer, probable transition point and drag of a given airfoil in a time which bears no relation to that formerly required for experimental and theoretical calculations in such cases.

To be quite exact, however, this statement must be somewhat limited, since theory can still not provide the transition point, if one can speak of such a thing, but it makes possible more precise forecasts on the stability of the boundary layer, or more exactly, the position of the points of instability on the surface of the body for all desired Reynolds numbers. It is important to know about instability, because as it shifts with changes in angle of incidence it causes the actual transition point to shift too. It follows that marked laminar effects at higher Reynolds numbers are possible only within a small range of lift coefficients. The breadth of this range with low drag increases with increasing airfoil thickness, so that thicker airfoils have a larger laminar region, and thinner airfoils a very narrow one. A great many measurements have been made which confirm this fact.

Lack of space prevents me from going into the newer flap forms of laminar flow airfoils. I should merely like to mention that great efforts are being made to have the flaps fit as smoothly as possible into the profile when closed, both on the top and on the bottom.

Surface finish and turbulence condition

Far more difficult than finding the profile drag or shape of airfoil required for

given design considerations is the actual technical realization of the values obtained. The reason for the practical difficulties arising lies in the very strict need for accurate observance of dimensions, as even slight deviations produce changes in pressure distribution and stability conditions in the boundary layer, which may easily lead to a premature transition to turbulent flow and hence jeopardize the whole design. Surface finish, such as roughnesses on the body, or turbulence in the air flow on arrival play a decisive part in the neighbourhood of the critical Reynolds number.

For the permissible degree of roughness as a function of the Reynolds number the reader is referred to the account given by H. Schlichting in his new book on boundary layer theory [2]. Many experiments have been made in connection with this problem, but have also met with considerable difficulties, as there are generally not sufficient wind tunnels available with low turbulence, and the suspension or other method of holding the experimental body in place frequently gives rise to powerful disturbances.

It is interesting to note, on the question of turbulence conditions in wind tunnels, that it was twenty years before the Tollmien-Schlichting theory of stability, which is at the basis of the transition problem, could be confirmed by experiments, as all earlier attempts at confirmation failed because of the excessively high *degree of turbulence* (T) in the wind tunnels. It was only in a new American wind tunnel with the extremely low ratio of mean fluctuation velocity to approach flow velocity of $T = 0.03\%$ that it could be shown that for a plate firstly the existence of the oscillations producing the transition forecast in theory cannot be proved until $T < 0.1\%$ and secondly that in general external disturbances produce the transition when the turbulence figure exceeds $T = 0.1\%$.

Influencing the boundary layer

In spite of the difficulties described, it has been possible to obtain in practice, to a great extent, large reductions in drag through keeping the flow in the boundary layer laminar. Unfortunately, this cannot yet be said of the other means of keeping flow laminar, that of influencing the boundary layer by absorbing or expelling the flow. It has been shown in theory that such measures can give important savings in drag, which can even be calculated quantitatively. But although experimental proof has also already been obtained in a few cases, there are still very great difficulties in the way of practical realization. Some of these are concerned with the form of the air duct inside the wing, and others with the configuration of a suitable single slot bleed system or the technical realization of a porous wing surface.

Induced drag

Mention must now be made of a type of drag which has not yet come within our field of view, but which plays its part in every design, namely induced drag. It is called thus from the fact that every wing of finite span (for any lift other than zero) induces, thanks to the vortex layer moving away behind it and gradually rolling up, an additional drag which is roughly proportional to the square of the lift coefficient and inversely proportional to the aspect ratio. These facts have been known since World War I. In the last decade and a half, however, methods of calculating lift distribution on wings of any desired shape have been so perfected that practical, rapid determination of the induced drag today forms part of all normal design calculations.

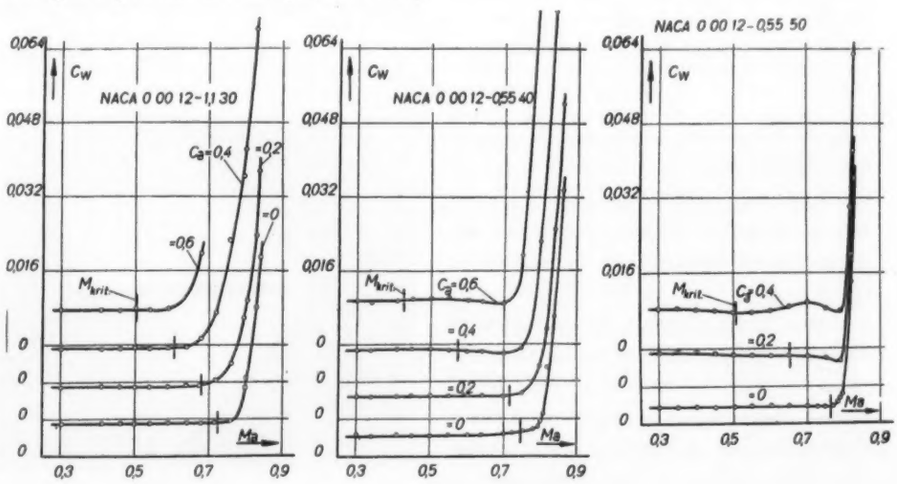
Influence of Mach numbers

Up to the present we have spoken only about the influence of friction on drag and have tacitly assumed that even at the high Reynolds numbers under discussion there is still incompressible flow. For suitable values for wing chord and kinematic viscosity [3] this is doubtless possible. When the flow medium is air, and with the wing chords occurring in practice, the flow velocity in relation to the speed of sound—the so-called *Mach number* (Ma)—is, however, so high that marked compressibility effects occur. To illustrate these, *fig. 4* gives a picture, taken during the war in a Brunswick high-speed tunnel, showing very clearly the completely different type of flow.

The Schlieren photos, which, as is known, render visible the pressure gradients in a flow, show clearly, for low Mach numbers, the powerful variations in velocity in the region of the stagnation point, the boundary layer getting thicker towards the rear, and the wake. The interference photos show lines of constant density. The number of them increases more and more sharply with increasing Mach number. If the Mach number is still further increased there appears for the first time, at $Ma = 0.73$, a small area of supersonic speed, which then rapidly enlarges. At $Ma = 0.77$ shock waves occur already and a powerful broadening of the wake points to the fact that there must be a marked increase in drag. A picture of measured pressure distribution and curves showing loss of momentum would bring clearly to light the onset of shock waves and amplified break-away phenomena through very powerful expansion of the momentum loss surfaces.

[3] Ratio of coefficient of viscosity μ to air density ρ, measured in cm^2/sec. Kinematic viscosity ν depends greatly on air temperature.

Fig. 5 : Effect of leading edge radius and displacement of maximum thickness of airfoils on the increase in drag at high Mach numbers (Göthert, 1944).



[2] Grenzschicht-Theorie, by Dr. Hermann Schlichting. Verlag G. Braun, Karlsruhe, 1952.

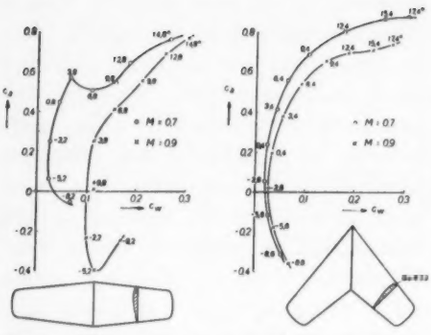


Fig. 6 : Effect of sweep, according to Göttingen measurements (Betz-Ludwieg, 1939).

This directly explains the great increases in drag which occur as sonic speeds are approached (Mach number 1). It is clear that excess velocity on the airfoil, and hence the shape of the airfoil, is of great influence on the onset of shock waves, and fortunately it has been found that the pressure distributions on airfoils whose maximum thickness is further back than in normal airfoils and which have a smaller leading edge radius, and thus have a laminar effect at higher Reynolds numbers, are also more suitable for higher Mach numbers, *i.e.*, they show an increase in drag only at higher Mach numbers.

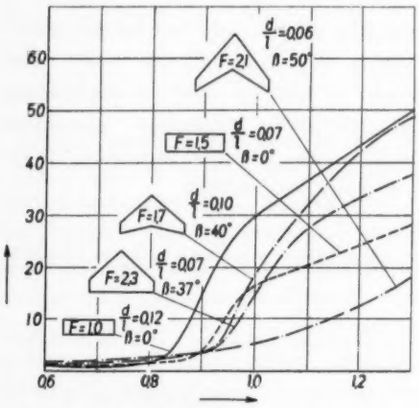


Fig. 7 : Wing designs for subsonic and supersonic ranges (Clifton, 1952).

In *fig. 5* this behaviour is seen in conventional and in more recent airfoils. It is seen that by moving back the maximum thickness and reducing the leading edge radius the critical Mach number can be shifted to higher values. A striking point of this picture is that at lower c_a-values the critical Mach number is passed fairly early for these airfoils, but that the increase in drag nevertheless does not set in until much later. This is because the critical Mach number (the Mach number at which the speed of sound is exceeded locally) occurs in a region where the boundary layer is still so thin and, thanks to the favourable change in pressure distribution, so stable that even small shock waves cannot cause it to break away.

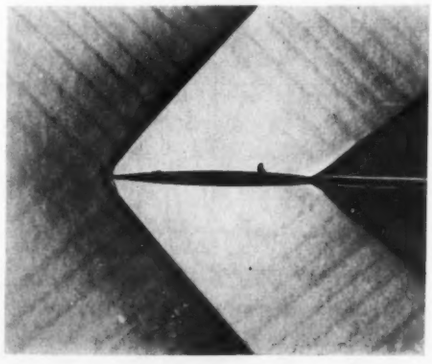
In wings of finite span there is another possible method of postponing drag, namely the sweeping back of the wing profile suggested by Betz. *Fig. 6* shows the influence of sweep with two polars for $Ma = 0.7$ and $Ma = 0.9$, according to measurements made at Göttingen in 1939. Characteristic features of modern aircraft projects designed to fly at very high sub-sonic Mach numbers or even to exceed sonic speeds are therefore 1) strongly swept wings and 2) low thickness ratios.

This is seen clearly in *fig. 7*, which shows the drag of a number of British wing designs (for the same landing speed). Wing areas, in proportion to the rectangular wing, are marked inside the outlines. It is seen that, even though its wing area is double, the wing with the 50° sweep and low thickness ratio of 0.06 is superior to all the others.

Supersonic speeds

We have thus boldly crossed the sonic barrier, and the last curves shown almost make it seem as if this crossing were now already under control. Unfortunately, however, this is by no means the case, on the one hand because wind tunnels cease to be of any use as test installations in the neighbourhood of the speed of sound, so that here only the much more tedious and costly dropping, flight and firing tests can be used, and on the other because even theory can make only slow progress, thanks to the change in type of the differential equation. Nevertheless laws of similarity have been discovered during the past ten years that enable at any

Fig. 8 : Supersonic flow about a symmetrical segment airfoil.



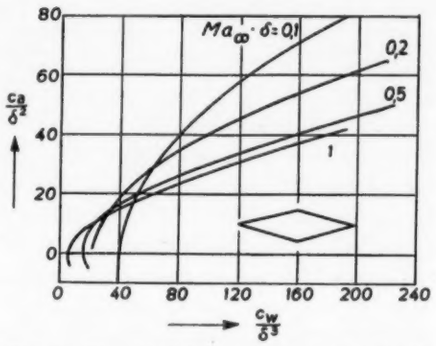


Fig. 9 : Theoretical drag coefficients for a double wedge airfoil in the hypersonic range ($5 < Ma < \infty$: Linnell, 1948).

rate useful estimates to be made. At supersonic speeds both theory and experiment once more become simpler, at least up to Mach numbers of approximately 3 or 4.

Let us look once more at a flow diagram *(fig. 8)* to get a clear idea of the flow in this case. The flow runs from left to right, and the shock waves forward and aft are clearly recognizable. (The waves crossing the shock waves at right angles emanate from disturbances intentionally produced on the walls of the wind tunnel to show the exact parallelism of the air stream). The drag effect is here to a certain extent " continued " in the expansion and compression, or shock, waves. Drag at supersonic speed is therefore a wave drag, which unfortunately is of considerable magnitude and can be kept within reasonable bounds only by the use of the thinnest possible bodies.

In theory the determination of the pressure distribution on the airfoil is simple in such cases. It is obtained without difficulty from the local airfoil inclinations and thus also determines the body's drag. In every case there is also, of course, the effect of friction, and in the case of bodies with blunt rear ends the pressure on the rear also plays a certain part. However, all that exists on the latter are more or less reliable estimates. Behaviour in the case of cylinder and sphere and of certain projectile shapes has been measured up to Mach 3 or 4. *Fig. 9*, finally, gives a theoretical result for the range of hypersonic flow, namely the Mach number range from about 5 to infinity. Here the polars for small thickness ratios have been calculated, according to a new theory for double wedges. It should be noted that the lift coefficient is proportional to the square of the thickness ratio, but the drag is proportional to its cube.

Planes and Politics

By Chris Roberts, Washington.

The " lead time " required for the production of military aircraft and the rather involved financial customs of the United States Congress have suddenly come face-to-face in the 1953 fiscal year budget for the U.S. Department of Defense—with the danger of admittedly dire consequences to U.S. air preparedness.

There are two basic facts that must be clearly understood in order to appreciate the current crisis in aircraft procurement. The first of these, alread y familiar to readers of *Interavia*, is the rather simple fact that some two or three years must elapse between the time an initial production order is placed for a combat airplane and the time the first of these airplanes is in actual squadron service. Even if the aircraft is already in quantity production, completed airplanes cannot be delivered for 12-18 months.

The other fact is not so simple and comprises the methods used by the Congress for providing funds to the government. Each year the Congress provides money in two forms : actual appropriations, which consist of cash ready for immediate spending, and " contract authority " or " obligating authority ", which permits the government agencies to sign contracts for goods which may not be delivered for two or three years. This contracting authority thus passes on to two succeeding Congresses the obligation to provide money to pay these two- or three-year old bills. However, since the Congress is autonomous under American Constitutional Government, it may, or *may not*, honor these obligations. In practice, each fiscal year budget for each agency contains three kinds of funds : funds for the payment of previous obligations, funds for current operations and contracting authority for future procurement.

What has happened in the current situation is this : the *House of Representatives*, which originates all appropriations bills, attached an amendment (*the Smith-Coudert amendment*) to the fiscal 1953 Department of National Defense appropriation restricting its actual appropriations to a total of not more than $46 billion. Since the original Presidential request for the Defense Department was about $52 billion, this means that some $6 billion was automatically cut from the budget. Meanwhile, the *House Appropriations Committee* slashed the 1953 Defense budget from the original $52 billion to about $47.2 billion. In the latter case the House did the cutting ; under the Smith-Coudert Amendment the Department of Defense would have to do the cutting.

The $4.7 billion slash in the budget made by the House includes a reduction of $150,000,000 in Naval Aviation aircraft procurement and $560,000,000 in U.S. Air Force aircraft procurement. This money is in actual cash available for the liquidation of previous contracts and for current operations. This means, for example, that the Air Force will have $560 million less than it needs to pay for combat aircraft now coming off the assembly lines—planes ordered two or three years ago !

This cut not only would be bad in a normal budget, but the fiscal 1953 Air Force budget contains an exceptionally large number of old contracts, deliveries on which are now being made. For example, the fiscal 1952 budget contained $5.8 billion for actual expenditure in paying for airplanes delivered whereas the new fiscal 1953 budget contains $11 billion for this item. The Air Force simply has more airplanes rolling off the production lines—which must be paid for in cash—today than at any time since World War II.

It is for this reason that Air Secretary Thomas Finletter has said that the House slash will cost the Air Force about 3,000 airplanes. Actually, the fiscal 1953 budget contains an item of $10.6 billion for new contracting authority and this is virtually unaffected by the current cuts since it is a bill that will not have to be paid for some 18 months. But the $560 million slash is for bills coming due immediately—and that comprises the seriousness of the situation. *

The defense cuts imply no loss of Congressional faith in U.S. Air Power, since the fiscal 1953 budget contains liberal amounts of contracting authority for future production. The Smith-Coudert Amendment is simply an election-year economy-slash that is " across the board " and merely attempts to limit actual Defense Department cash spending during the 1953 fiscal year (July 1st, 1952-June 30th, 1953).

Here is a step-by-step history of the 1953 fiscal year budget :

1. The original budget asked for $21.4 billion for the Air Force as part of a $55 billion defense budget. This $21.4 billion would have provided an effective 143-wing Air Force by July 1st, 1954.

2. The budget was revised by the President to lower the defense ceiling to $52.4 billion and to reduce the Air Force budget to $20.7 billion. This reduction of $700 million had the effect of delaying the Air Force expansion program one year, so that the 143-wing Air Force was re-scheduled for July 1st, 1955. This is the so-called " stretch-out " budget.

3. The House of Representatives then cut this budget from $52.4 billion to $47.2 billion, which reduced the Air Force budget from $20.7 billion to $19.2 billion. This reduction includes a total of $560 million for aircraft procurement. This would stretch the target date for the 143-wing Air Force to July 1st, 1956.

4. Attachment of the Smith-Coudert Amendment, known officially as Section 638 of House Bill 7391 (the Military Appropriations Bill for 1953), to the bill would result in a further reduction of the Air Force item from $19.2 billion to only $17.4 billion. This would have the effect of postponing the 143-Wing Air Force attainment target date to July 1st, 1957.

Thus, according to Secretary Finletter, repeated reductions in the Air Force budget for the 1953 fiscal year have pushed back the 143-Wing target date from an original goal of July 1st, 1954 to July 1st, 1957—or three full years. Since the original target date of 1954 was considered the time at which Russia would attain a striking force capable of launching a serious attack, postponement of the target date of maximum U.S. retaliatory strength beyond that presents the danger so vehemently cried by the Secretary, and the repeated one-year delays with each of the measures makes the danger grow in giant strides with the current July 1st, 1957 date deemed a virtually useless one.

This is the situation as this is being written. The Congress has announced its intention of adjourning in order to attend the presidential nomination conventions early in July. This means that the Defense Appropriation bill must—and probably will—be passed by that time. It has been passed by the House in the form outlined above and is now being considered by the Senate Appropriations Committee. Here it is expected to receive a generous increase.

The reason why procurement observers in the Nation's capital are confident that the Senate will restore these cuts made by the House is the fact that the current political campaigns have become one of " who was most for the most Air Power " in the presidential and senatorial races. Air Power appropriations have become a powerful campaign argument and one in which the American people are at last becoming extremely interested. This popularity of the subject, together with the forceful and documented warnings testified by the Air Force and by the Department of Defense as to the probable consequences of such reductions, are certain to restore most if not all of the cuts so far made. It is generally believed that the final Bill would provide funds for attainment of the 143-Wing Air Force, considered the minimum needed for the job, by July 1st, 1955. Most Americans hope so !

* *
*

* *Latest developments :*
At its session of June 30th, 1952, the Senate unanimously passed a defense budget of $46,403,000,912. The *cuts* in the Air Force budget made by the House of Representatives *were restored in full*. The U.S.A.F. therefore gets back the $560,000,000 by which it was cut, and should be able to complete its expansion to 143 wings by the middle of 1955.

Swift, Hunter and *Sabre*

vie with each other at N.A.T.O.'s Brussels Air Meeting

From Our Special Correspondent

Brussels, 13th July 1952. — " To demonstrate the high degree of preparedness of the air crew and other personnel of the Allied air forces and the remarkable quality of their equipment ", the N.A.T.O. authorities decided to organize their first " Air Force Days " at Brussels-Melsbroeck airport. Why Brussels ? Perhaps because it was there that in April 1948 a pact was signed which proved to be the first step towards the establishment of the North Atlantic Treaty, perhaps also because of Belgium's neutrality... in the field of aircraft manufacture owing to the lack of a national aircraft industry and, finally, because it was intended that the competing aircraft should start on a basis of equality.

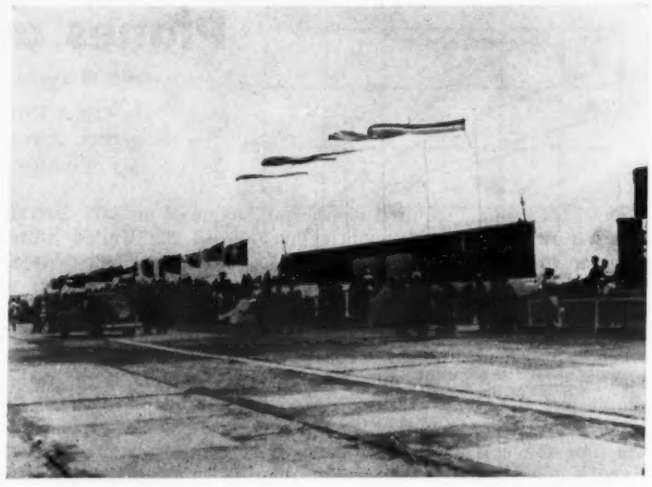
For it is a fact that the meeting was dominated by the competition of three fighter types, the Canadian-built North American *Sabre*, the Vickers Supermarine *Swift* and the Hawker *Hunter* ; only the Dassault *Mystère* was missing.

Before the King of the Belgians, who naturally was surrounded by General L. Leboutte, Chief of the Belgian Air Staff, and most of the top commanders of the Allied air forces—including General Lauris E. Norstad, Major-General David M. Schlatter, Marshal of the Royal Air Force Sir John Slessor, Lieutenant-General Aler, General Fay, General Ludovico Domenico and others—Flight Lieutenant Kelly, RCAF, D.W. Morgan and Squadron Leader Neville F. Duke went all out to show what their aircraft could do.

First to take off in his *Sabre*, the Canadian Kelly treated the immense crowds that had invaded Melsbroeck airport—much to the annoyance of the airline operators who were exiled to Antwerp for the afternoon—to the thunderclap which characterizes aircraft passing at near-sonic speed. He was equalled by Neville Duke, who made a remarkable impression as he shot past in his *Hunter* which he kept virtually at deck level after take-off. Morgan put his *Swift* into a straight climb and thus did not produce the explosive sound effect. He used a tail wind to beat up the field at very low height just above the stands... causing the King's cap to [tremble.] *Lèse-majesté*, or nearly.

The three pilots performed all the classic manœuvres in the book—loops, rolls, spins and so on. But the *Sabre*, with an absolutely vertical climb, including four rolls to the left and four to the right, outclassed its rivals. I did notice, on the other hand, a spin by Morgan's *Swift* with extended air brakes, as well as the *Hunter's* docility in its slow rolls. And personally I regretted the absence of Rozanoff who aboard his *Mystère* would certainly have tried to do better than a " fourth place "...

The Dassault MD 450 Ouragan *with its new wing-tip tanks, featuring vertical and horizontal tail surfaces.*

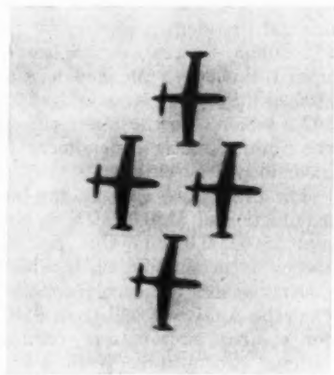


Before the start of air show. The NATO flags are flying in the background.

All the other displays, most of them conventional, were really subordinate to this rivalry, the winner's prize of which may well be a NATO contract. However, the four Republic *Thunderjets* of the " Skyblazers ", the U.S.A.F.'s precision acrobatics team, once again stole the show. This was their last exhibition in Europe. After having demonstrated its skill to nearly fifteen million spectators, including Europe's crowned heads and chiefs of State, the famous flight will now return to the United States to be disbanded. Second and third prize for formation aerobatics I would award to the four Belgian *Meteors* commanded by Captain Bladt and the four French *Vampires* of Colonel " GG " (Gauthier) in that order.

The British were scheduled to give a show of classic acrobatics with two flight of three *Vampires*, but after the first fly-past the " blue " flight was forced to land for technical reasons.

Flight Lieutenant Kelly's Sabre *seemed to outclass the other fighters.*



The Skyblazers *of the USAF stole the show in their* Thunderjets.

I was impressed by the excellent display by Chief Test Pilot Sonderman aboard his Fokker *S.14* jet trainer (particularly by a figure eight with a change of direction accomplished by means of a half-roll), by the boldness and skill of the Belgian Captain Bodart (who re-lit his jet about 15 feet above the ground), the now familiar performance of the *Canberra* bomber and the take-off... without smoke, of the SA-16 " Albatross " (but there is no rocket without fire !).

The final fly-past included French F-84 *Thunderjets*, American B-26 *Invaders*, B-29 and *B-50 Superfortresses*, Canadian *Sabres*, Italian, British and Norwegian *Vampires*, Danish and British *Meteors* and, at the end, 64 *Meteors* and 36 *Thunderjets* of the Belgian Air Force. As regards the 240 parachutists, they landed closely grouped a few dozen feet away from the Royal Grandstand in spite of the strong wind.

The whole show took place without a hitch. The timing in particular was precise. As the organizer of the French National Air Display at Orly two years ago, I know what difficulties have to be overcome to achieve such a result, and Colonel de Soomer and Major Morel deserve to be congratulated on their success.

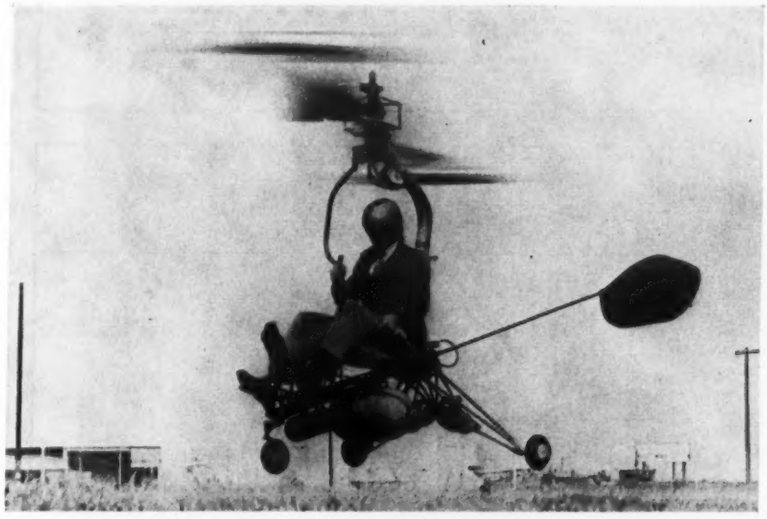
If other NATO air displays are scheduled for the future, as has been forecast, it would seem a good idea to change the general formula. In spite of its considerable interest and success, the Melsbroeck display tended to be a little tedious at times: there is nothing that resembles a display of *Vampire* aerobatics as much as another display of *Vampire* aerobatics. I feel that solo shows and formation displays should be alternated; more emphasis ought to be placed on the fly-pasts and spectacular " numbers " should be added, such as air races over short circuits, forcing the competitors to pass the stands at short intervals, competitions for aerobatic formations, simulated attacks on ground areas preceding their occupation by paratroops, etc.

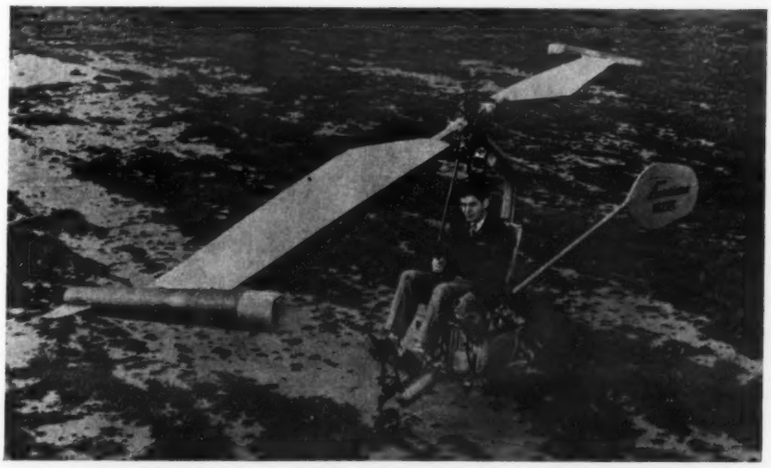
The purpose of these shows is to get as many people as possible to the airfields in order to provide them with tangible proof of the strength of the NATO air forces. The best means of drawing a crowd still is to give them a spectacular show.

Georges FÉVRIER.

240 paratroops landed close together near the King's stand.

The American Helicopter *"Buck Private"*





After the success of their first machine, the XA-5 " Top Sergeant ", the American Helicopter Company, of Manhattan Beach, California, a few months ago brought out another experimental helicopter powered by pulse jets, known as the XA-6 " Buck Private ". The " Top Sergeant " is of course older and more experienced than the " Buck Private ". The former can today look back upon three years of flying experience *. The " Buck Private " did not get into the air until 1951, although it was designed, built and got ready for testing in record time—less than six months.

Like its predecessor the XA-5, the " Buck Private " has a jet-driven two-bladed rotor. At the tip of each blade there is a pulse jet built to the company's own plans. The backbone of the small helicopter is formed by a bent light metal tube, which carries the rotor, pilot's seat, fuel tank, three-wheel undercarriage, and controls. In view of the extreme simplicity of its structure, it is not surprising that the empty weight of this helicopter should be only 200 lbs, and that the load may be several times the empty weight. Maintenance of the machine also should not be too difficult.

The pulse-jet helicopter seems predestined primarily for military use. It will play the part of " pack-horse " in the Army, and it is to be expected that everything possible will be done to perfect it.

* Flight testing started in January 1949; cf. INTERAVIA Review of World Aviation, No. 4, April 1949, pp. 220-221.

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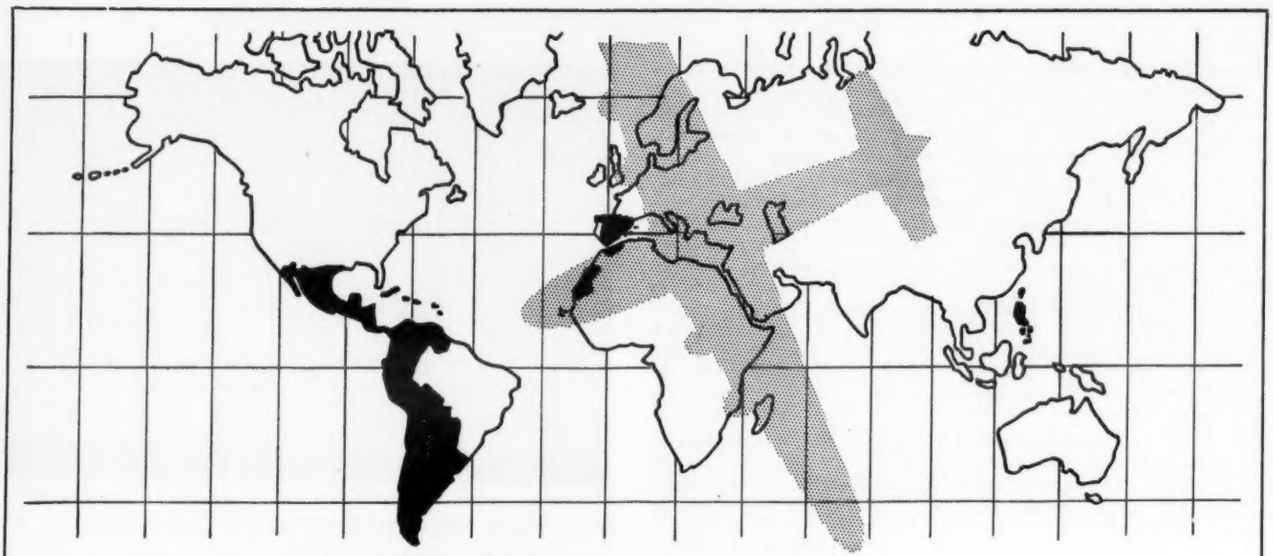

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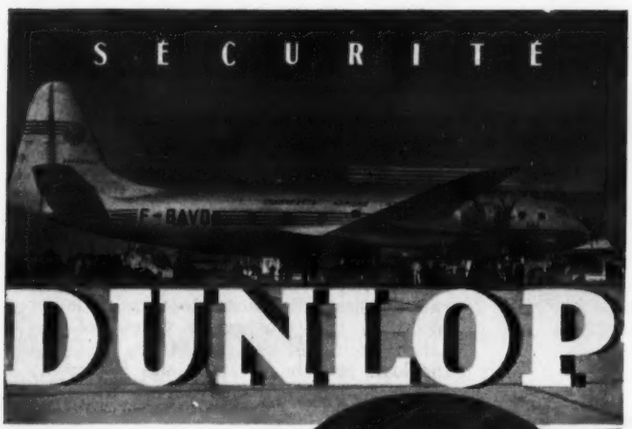

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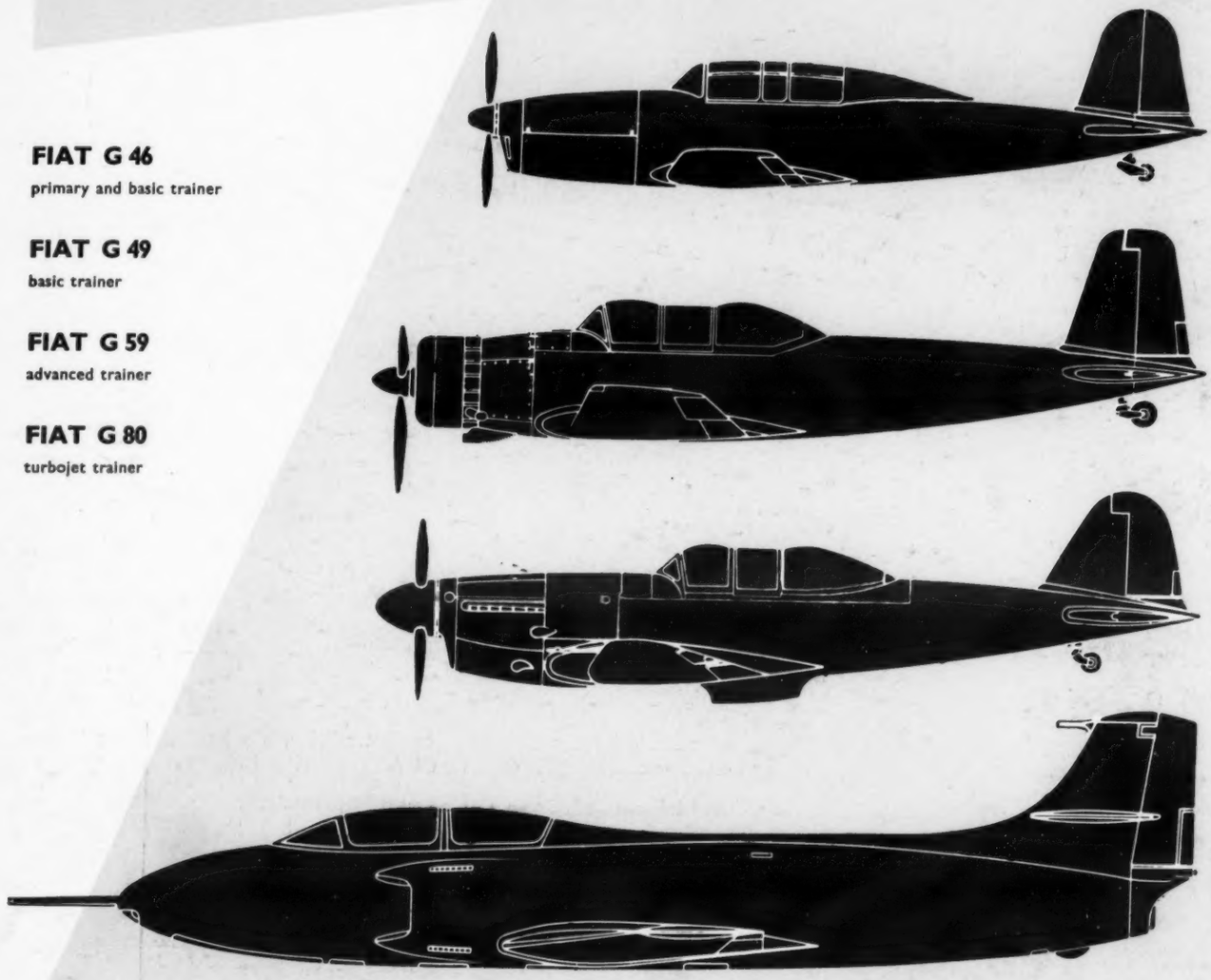

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